BAILLIÈRE'S ATLAS OF THE HORSE.

ITS ANATOMY & PHYSIOLOGY.

BY

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ATLAS
OF
THE ANATOMY AND PHYSIOLOGY
OF
THE HORSE

BY

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WITH ORIGINAL PLATES BY

GEORGE DUPUY, M.D.

CONTENTS

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1918

PLATES

Plate A.

Fig. 1
Fig. 2
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.
Fig. 17.
Fig. 18.
Fig. 19.

Plate I.

Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

Plate I.

Fig. 4.

Fig. 2.

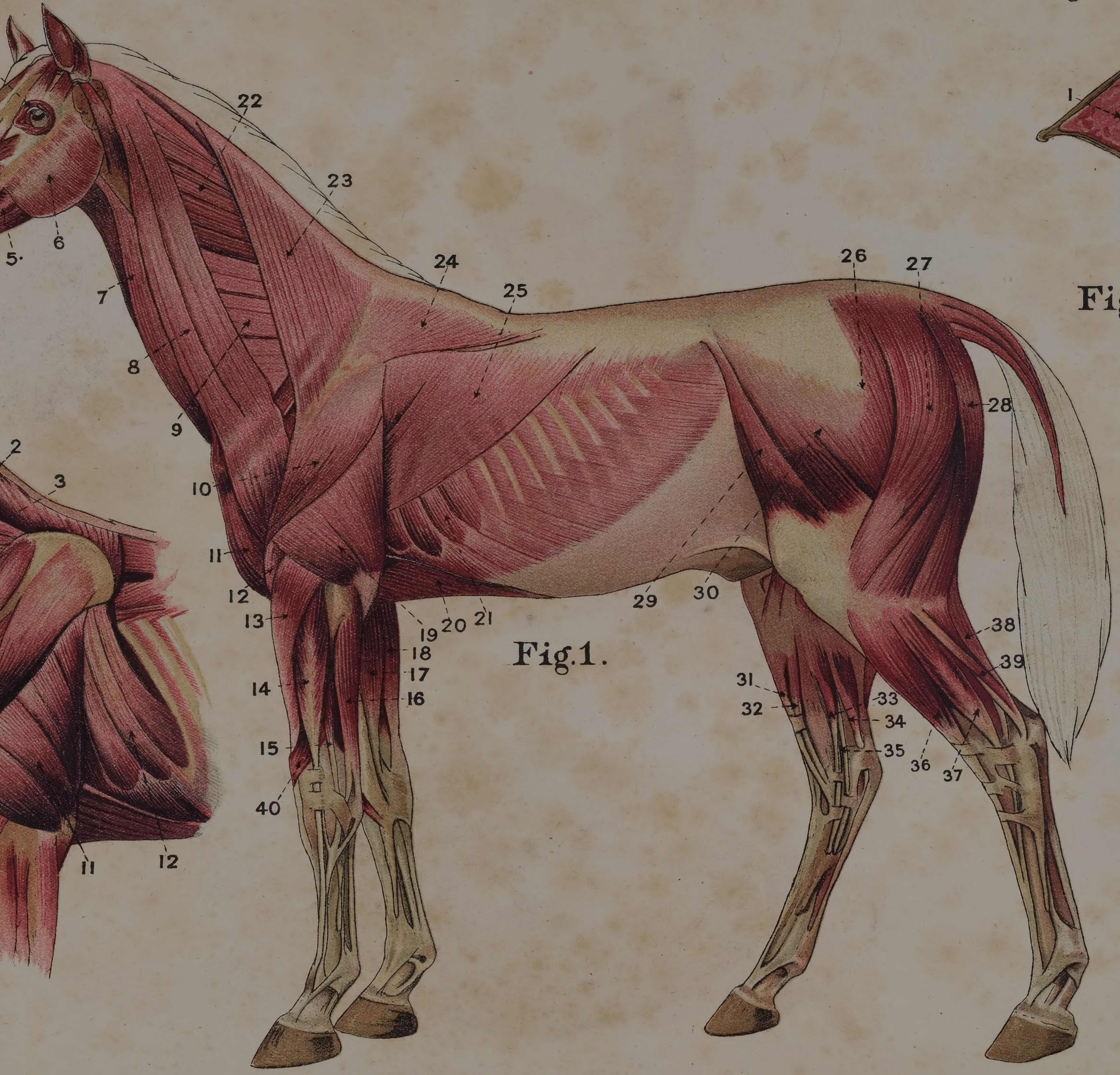

Fig. 1.

Fig. 3.

Fig. 5.

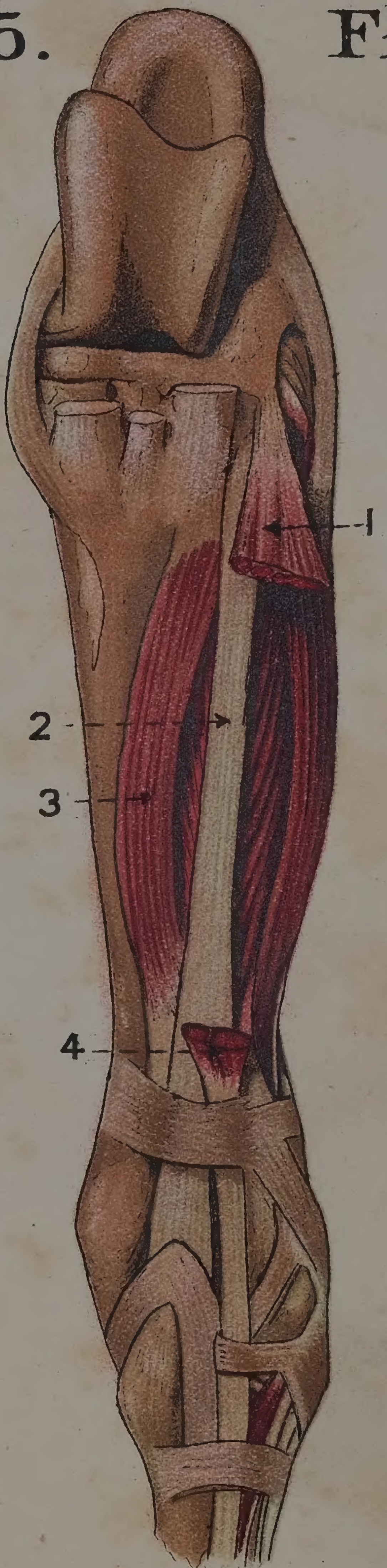

Fig. 6.

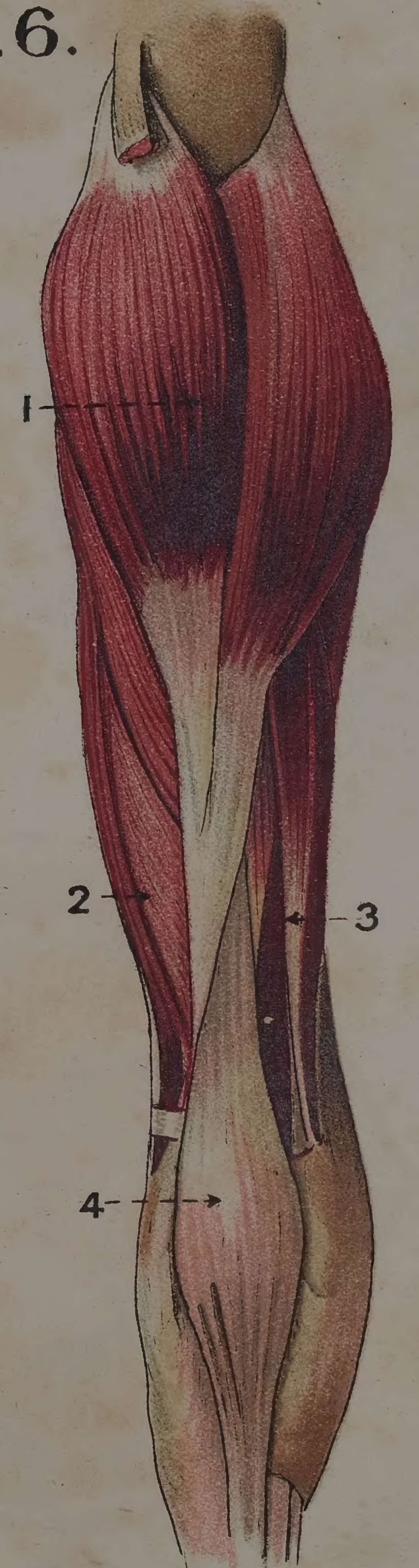

Plate II.

Fig. 2.

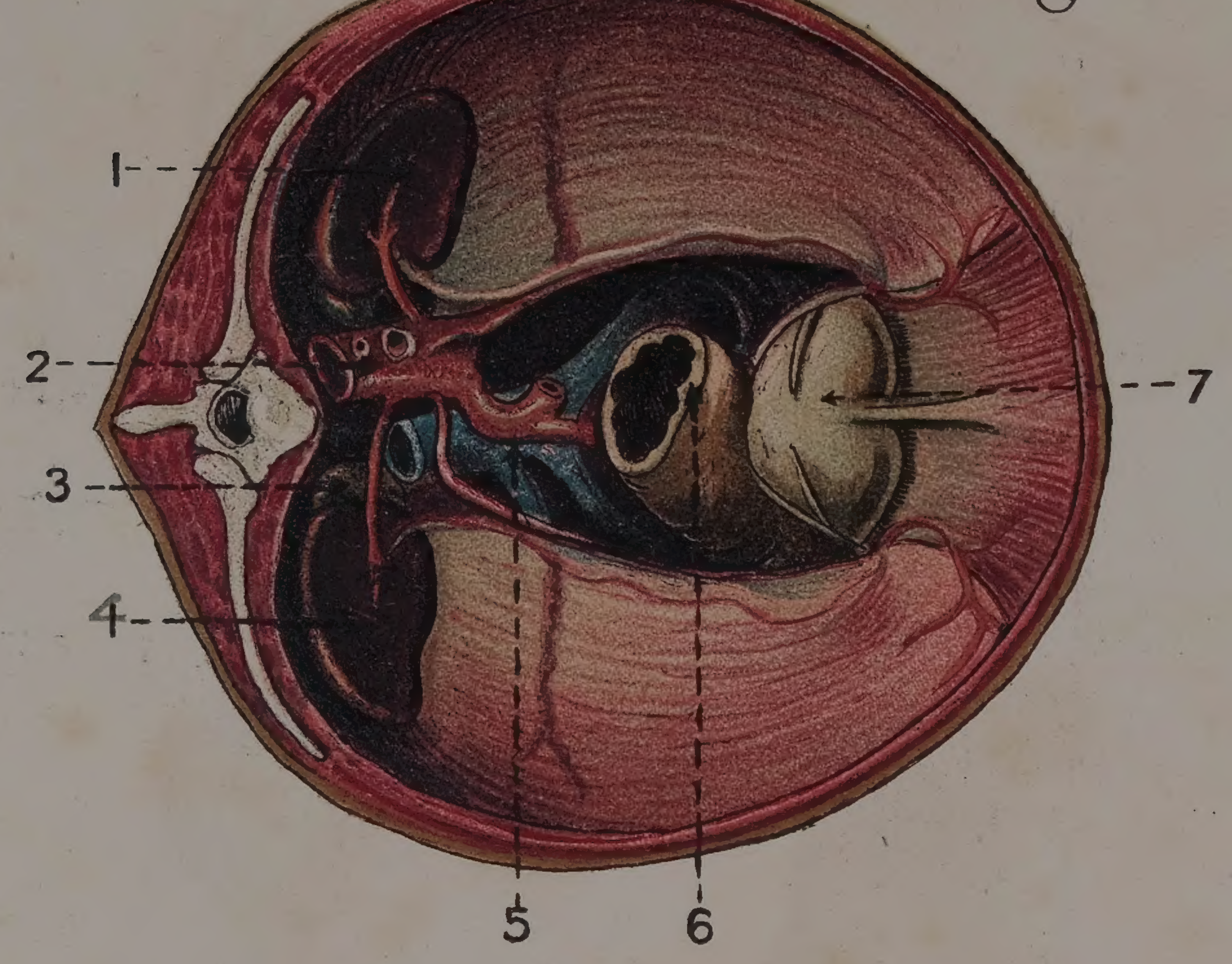

Fig. 4.

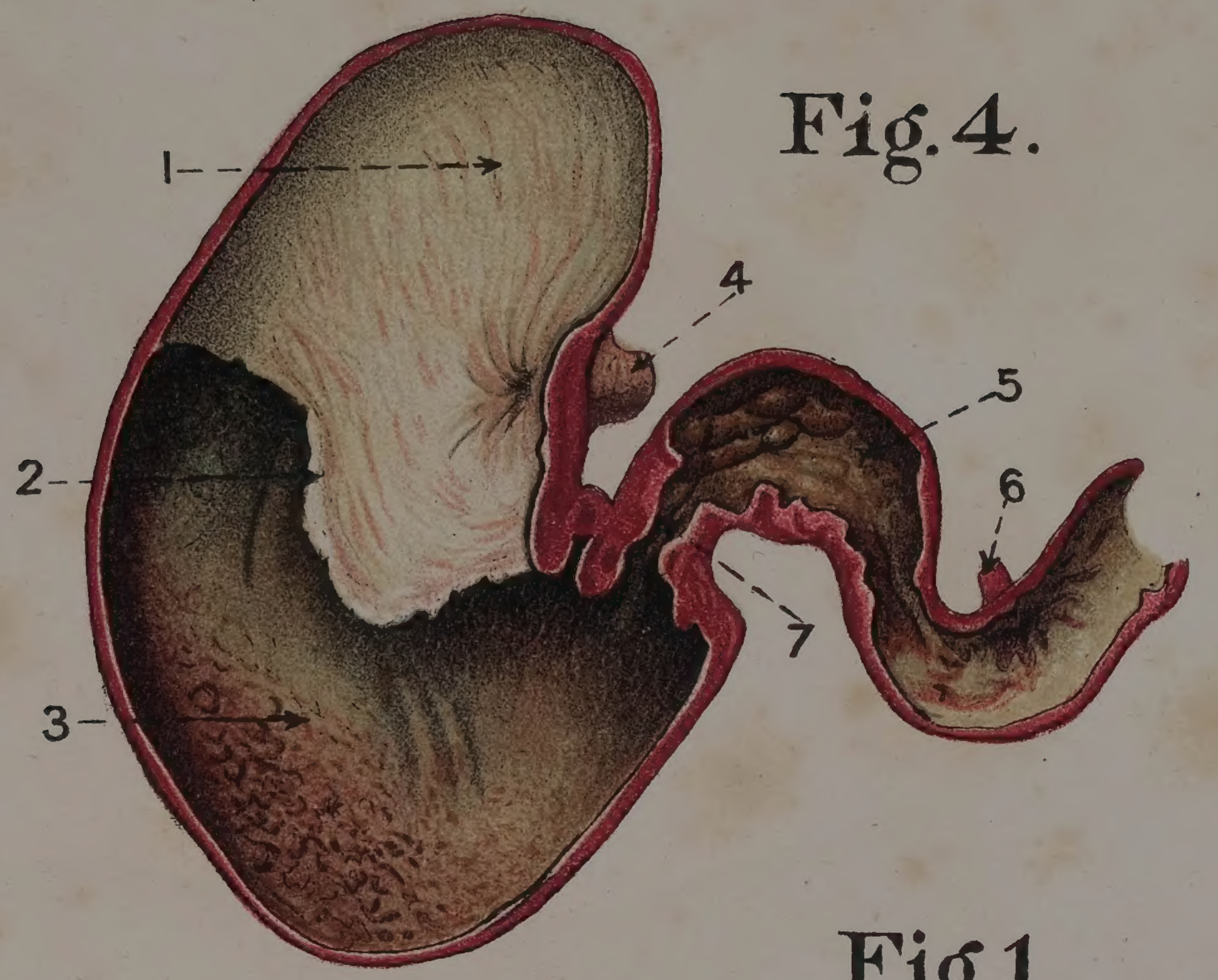

Fig. 5.

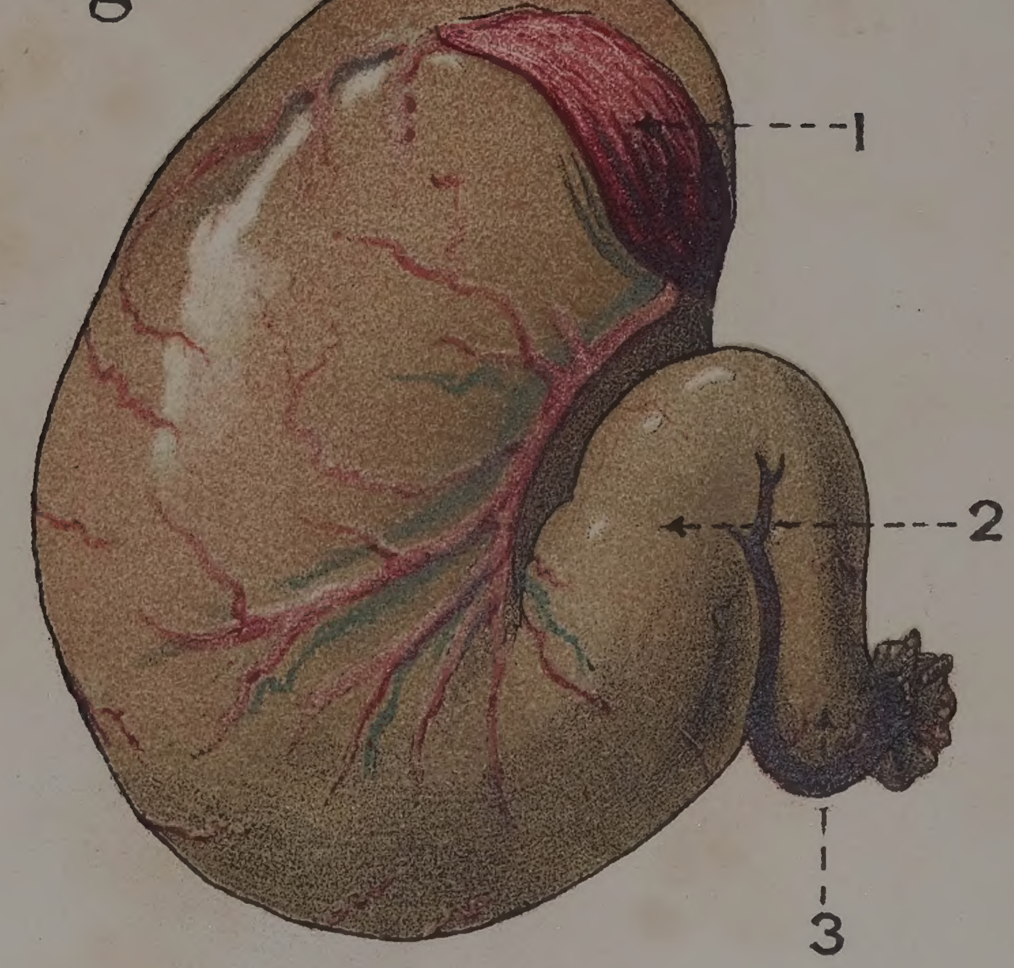

Fig. 1.

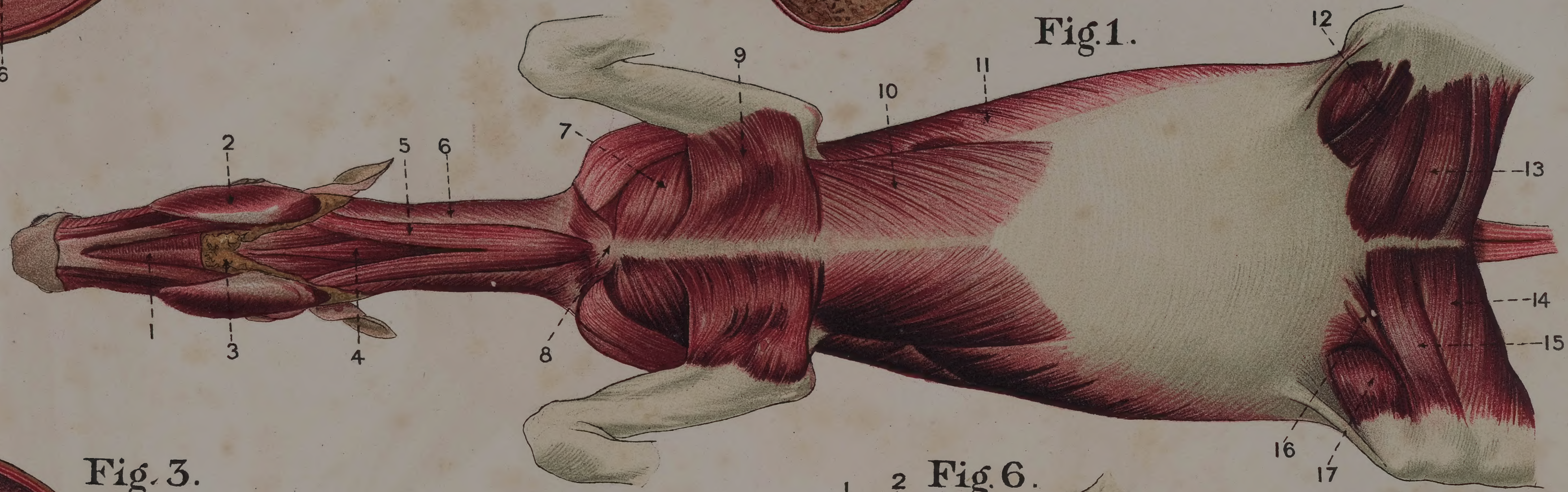

Fig. 3.

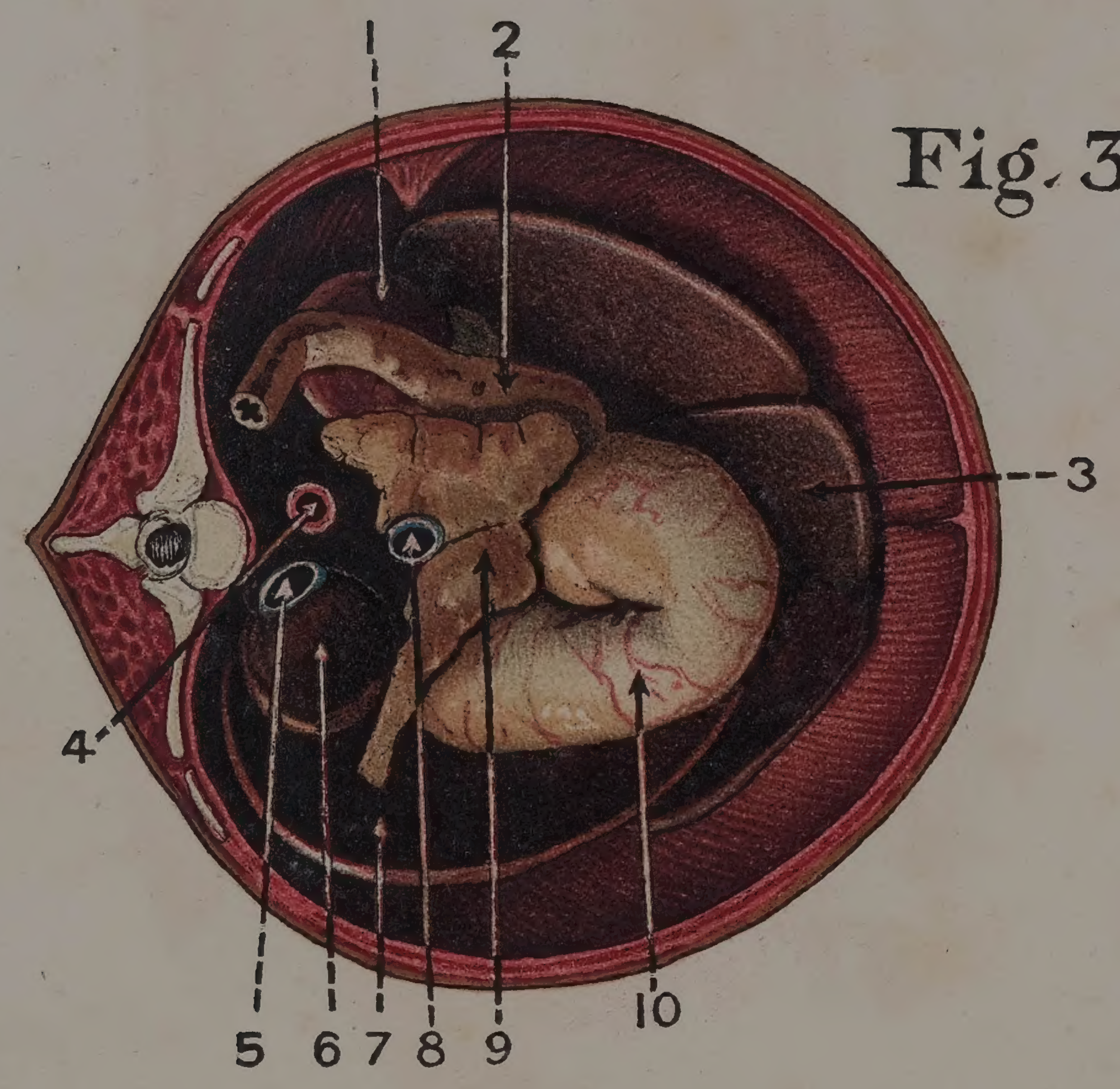

Fig. 6.

Fig. 7.

Plate B.

Fig. 1.

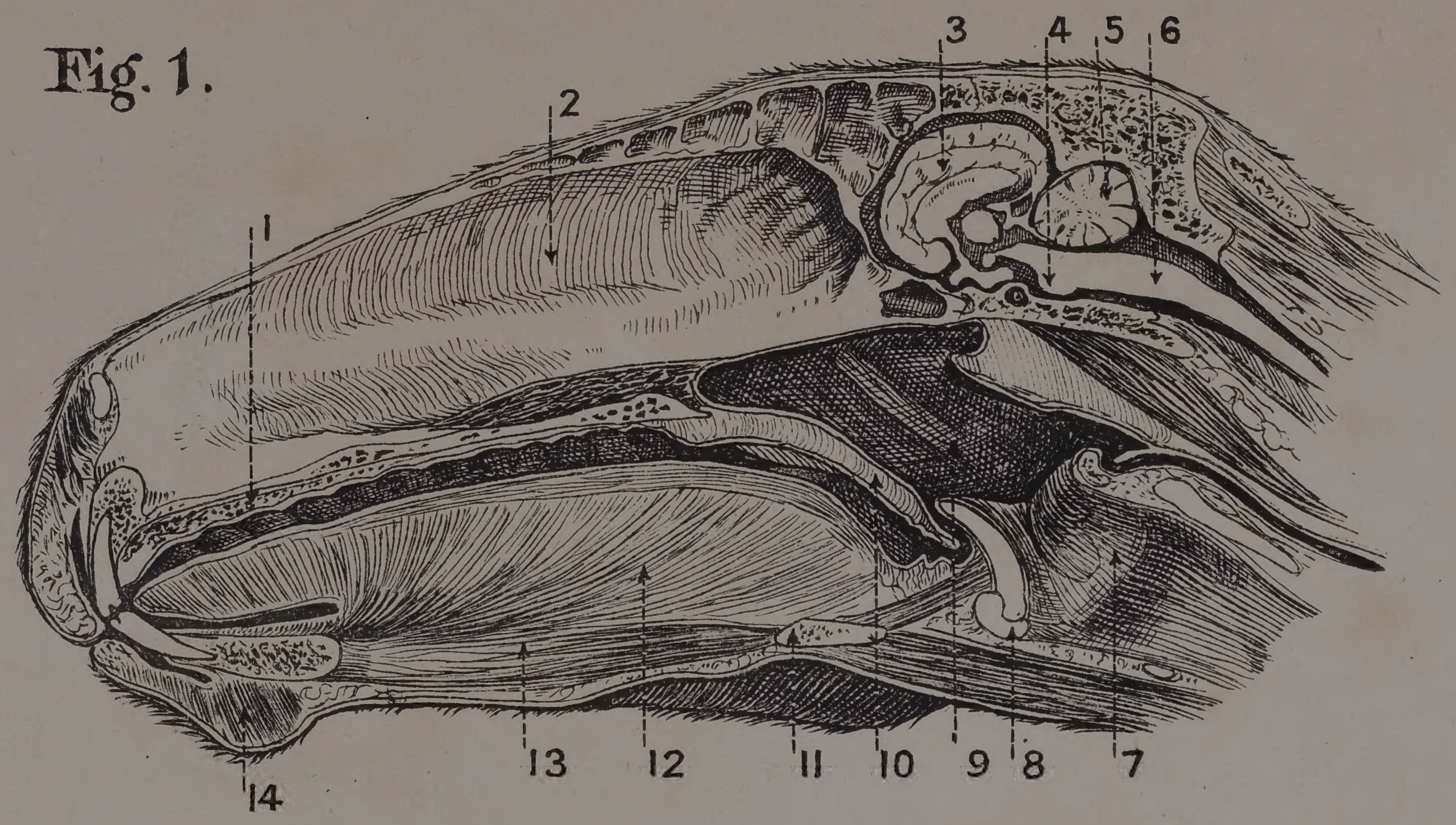

Fig. 2.

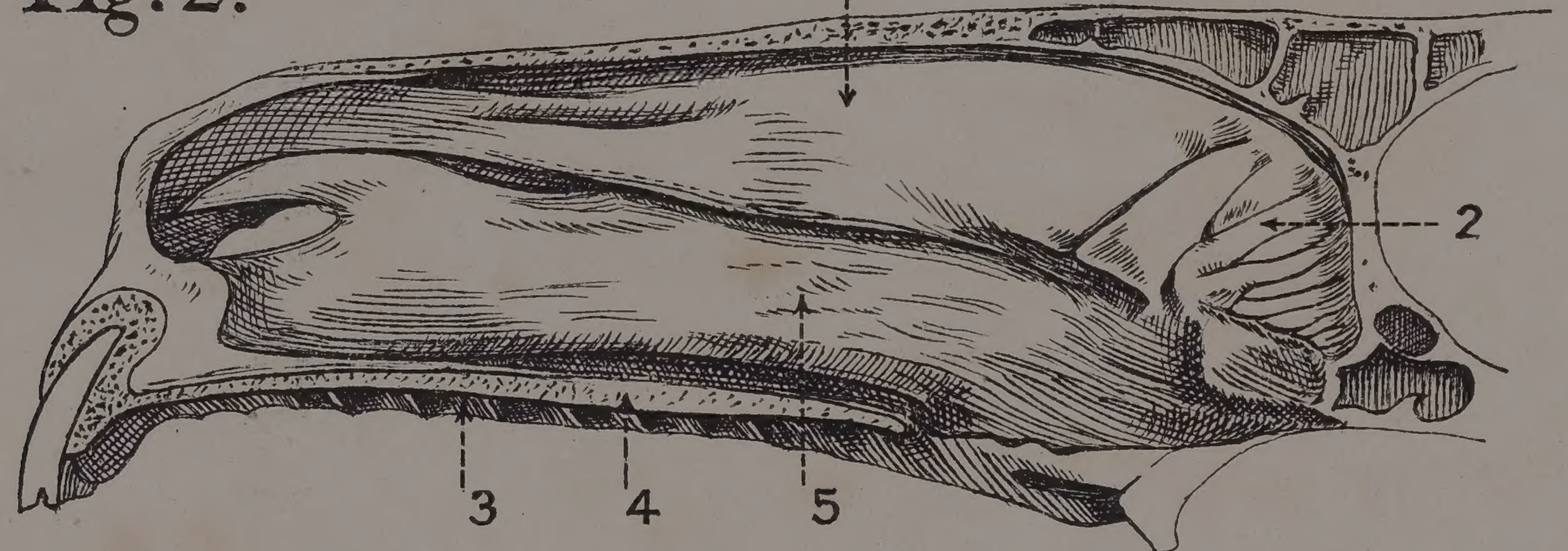

Fig. 3.

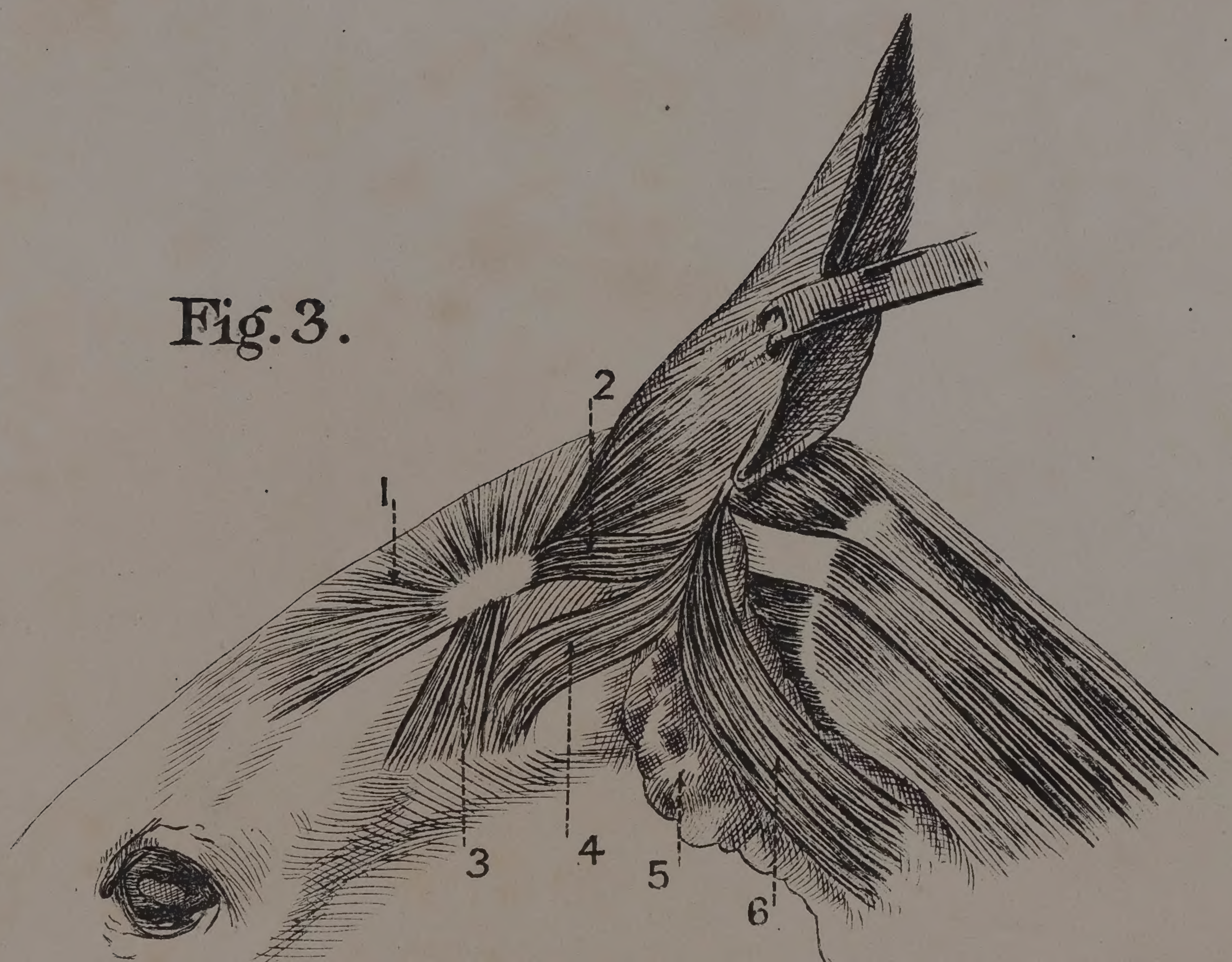

Fig. 4.

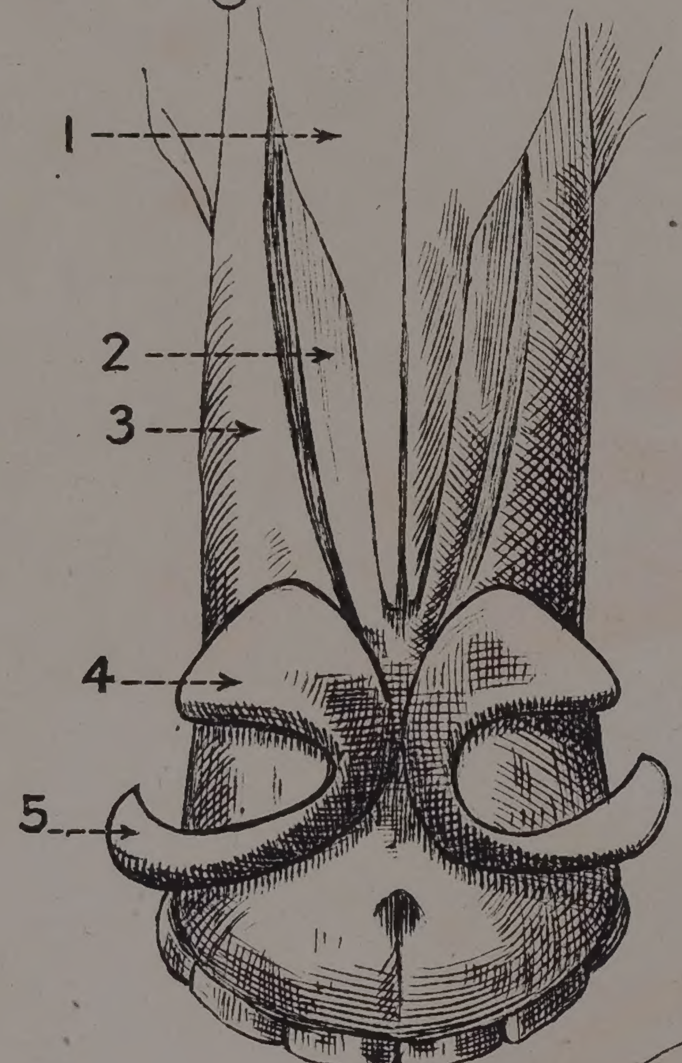

Fig. 5.

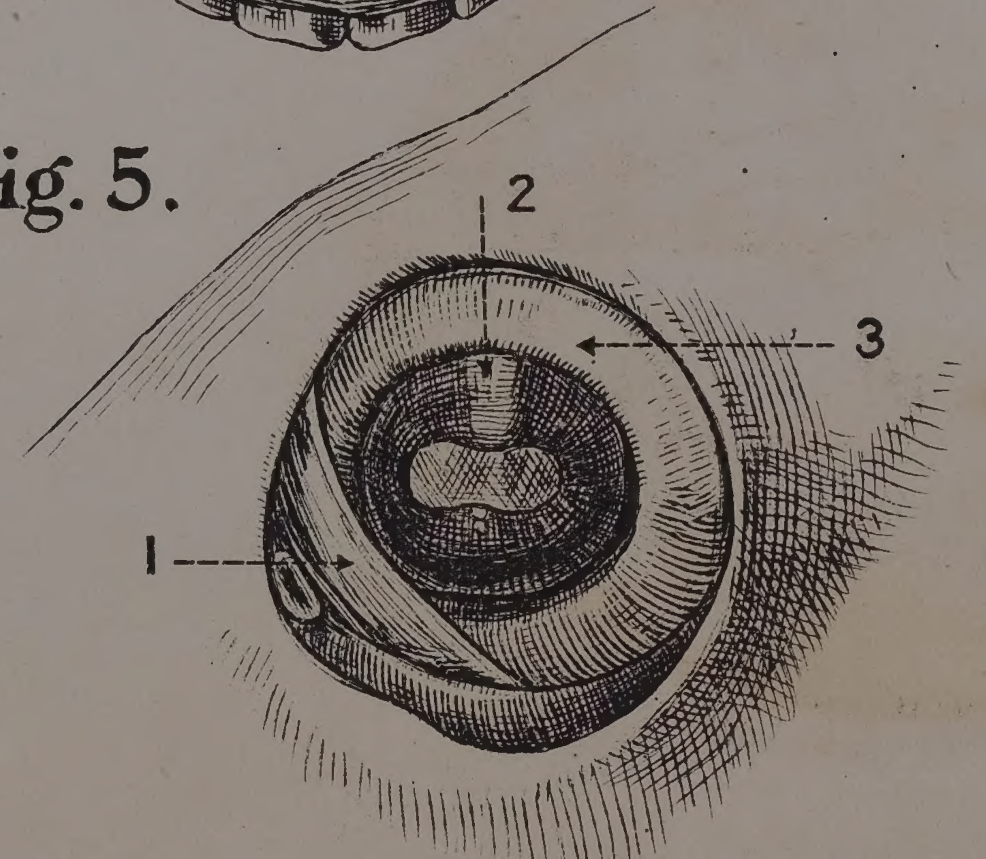

Fig. 6.

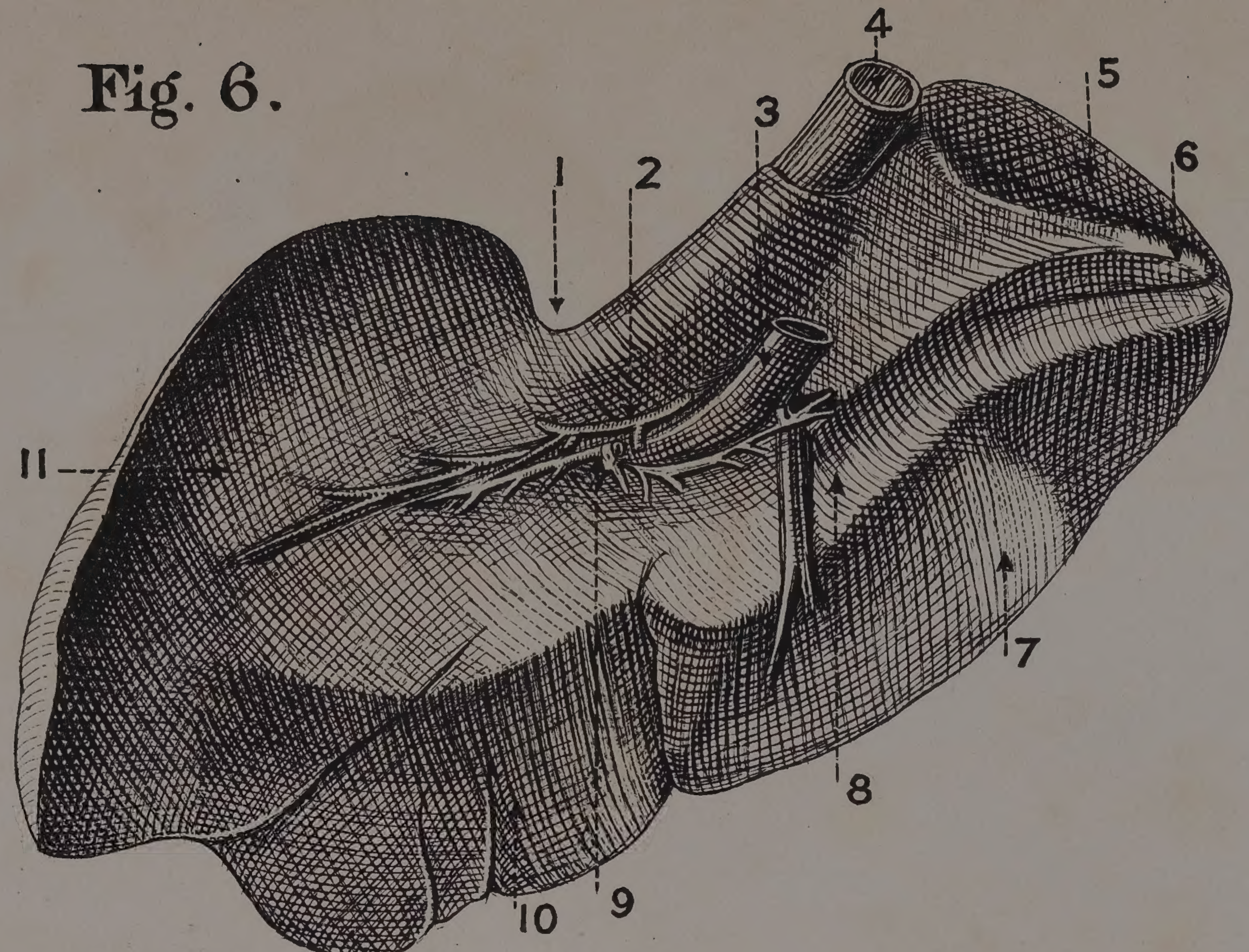

Fig. 7.

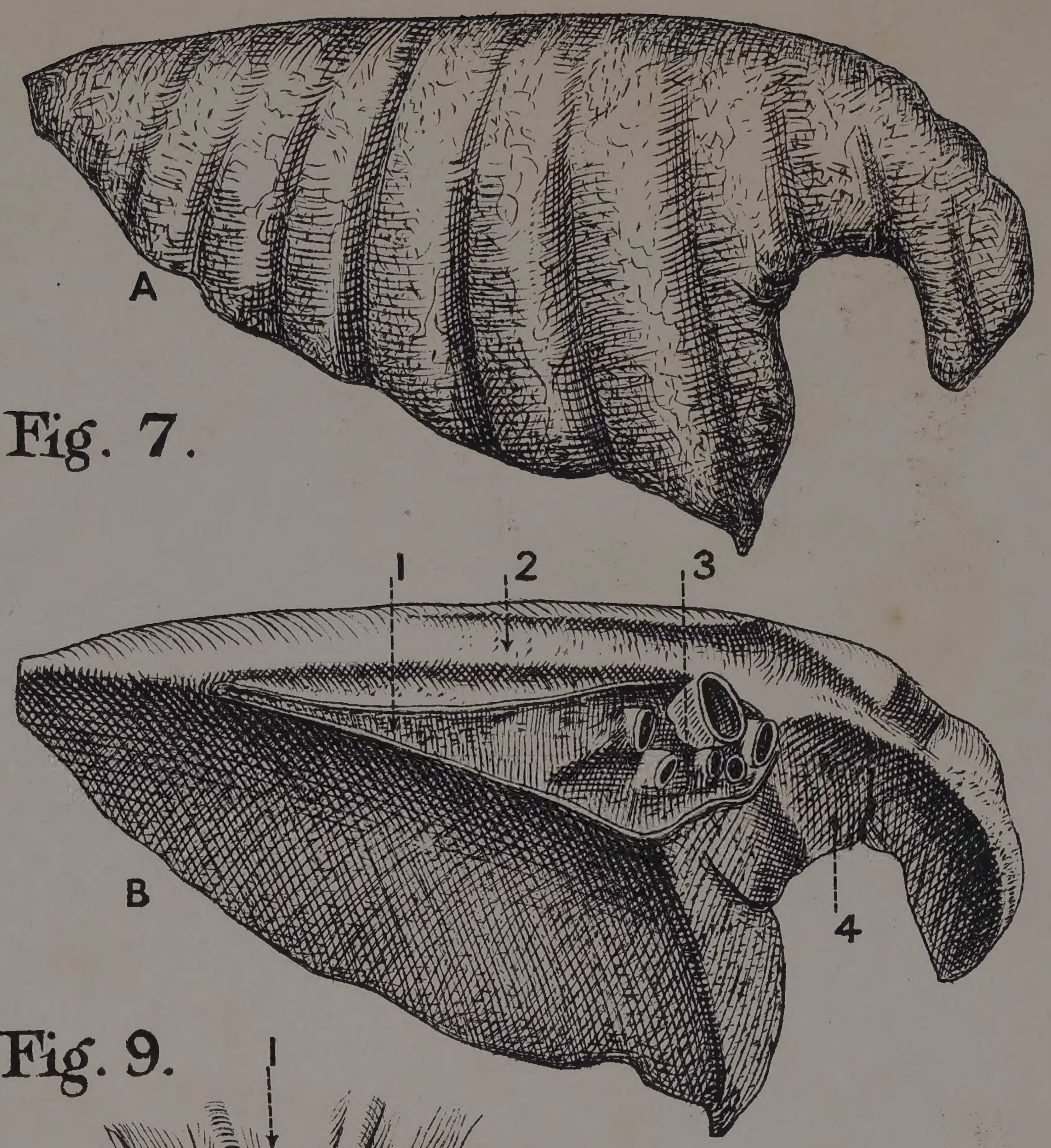

Fig. 8.

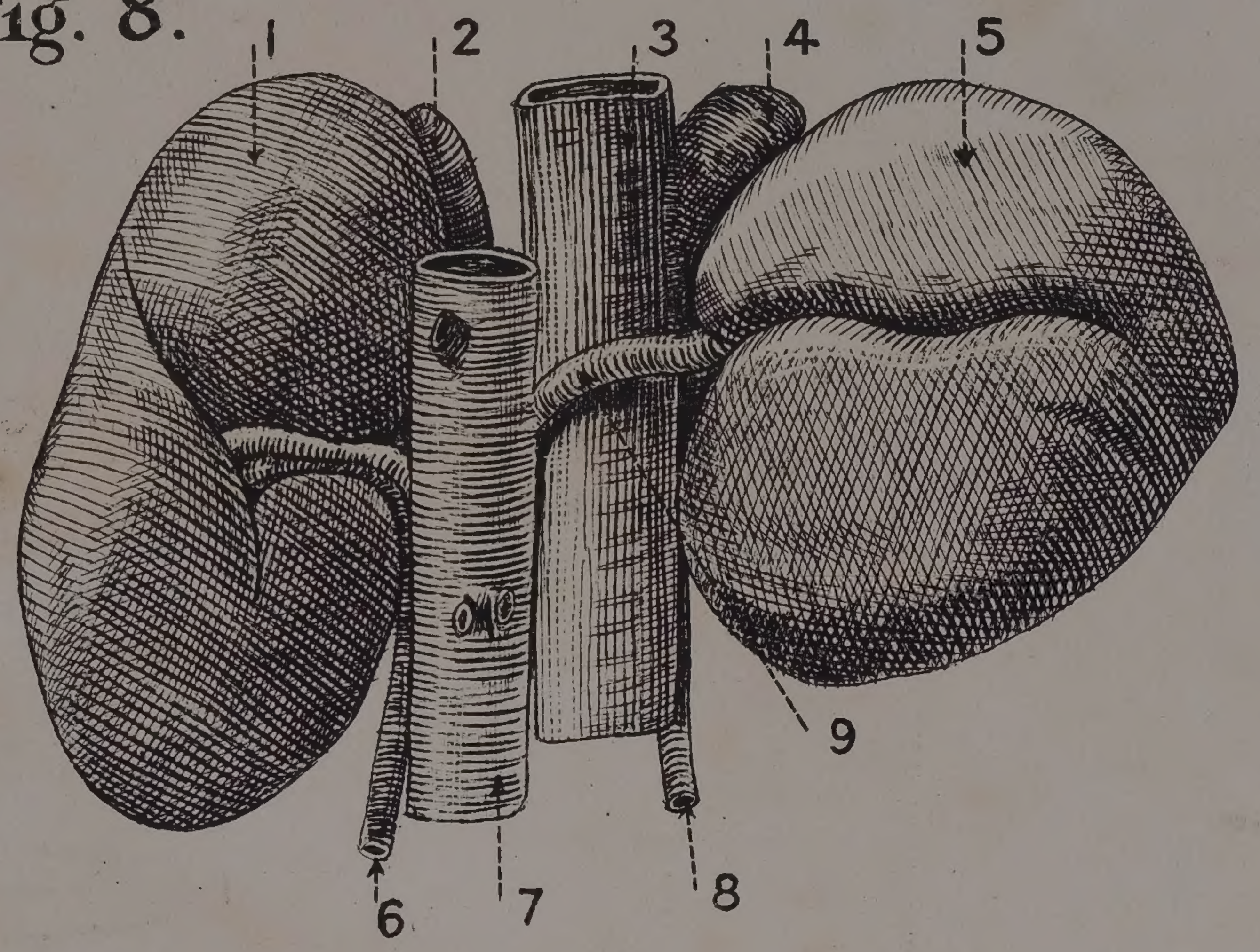

Fig. 9.

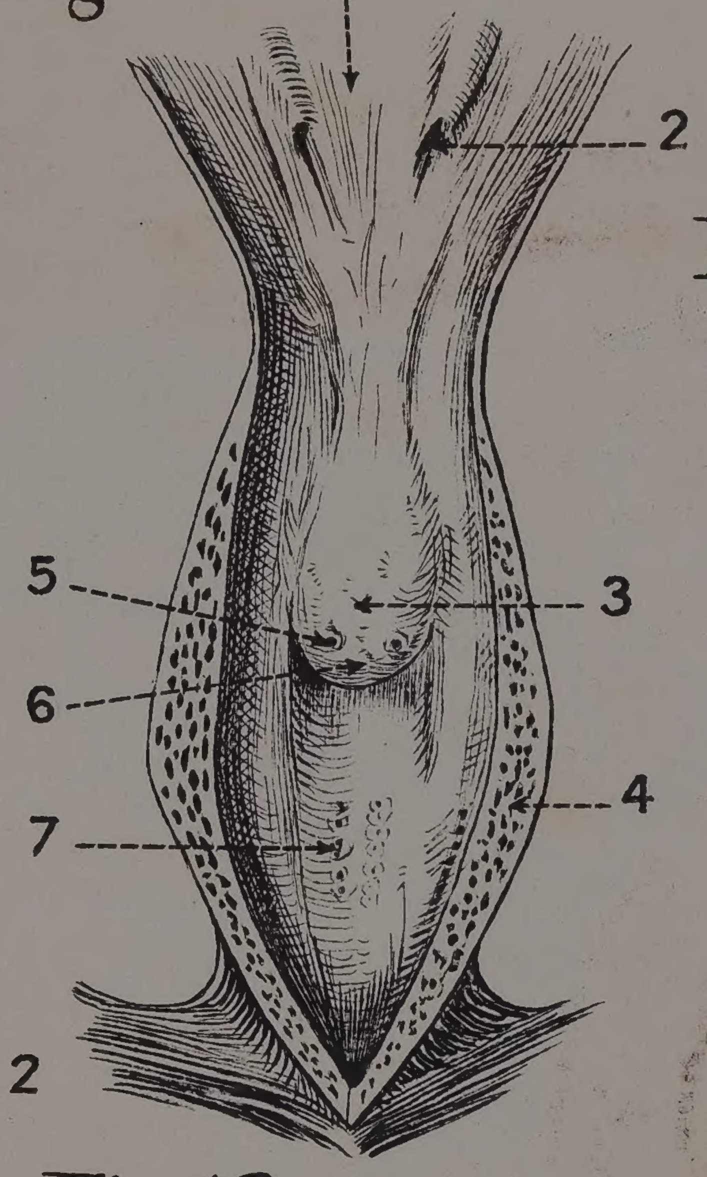

Fig. 10.

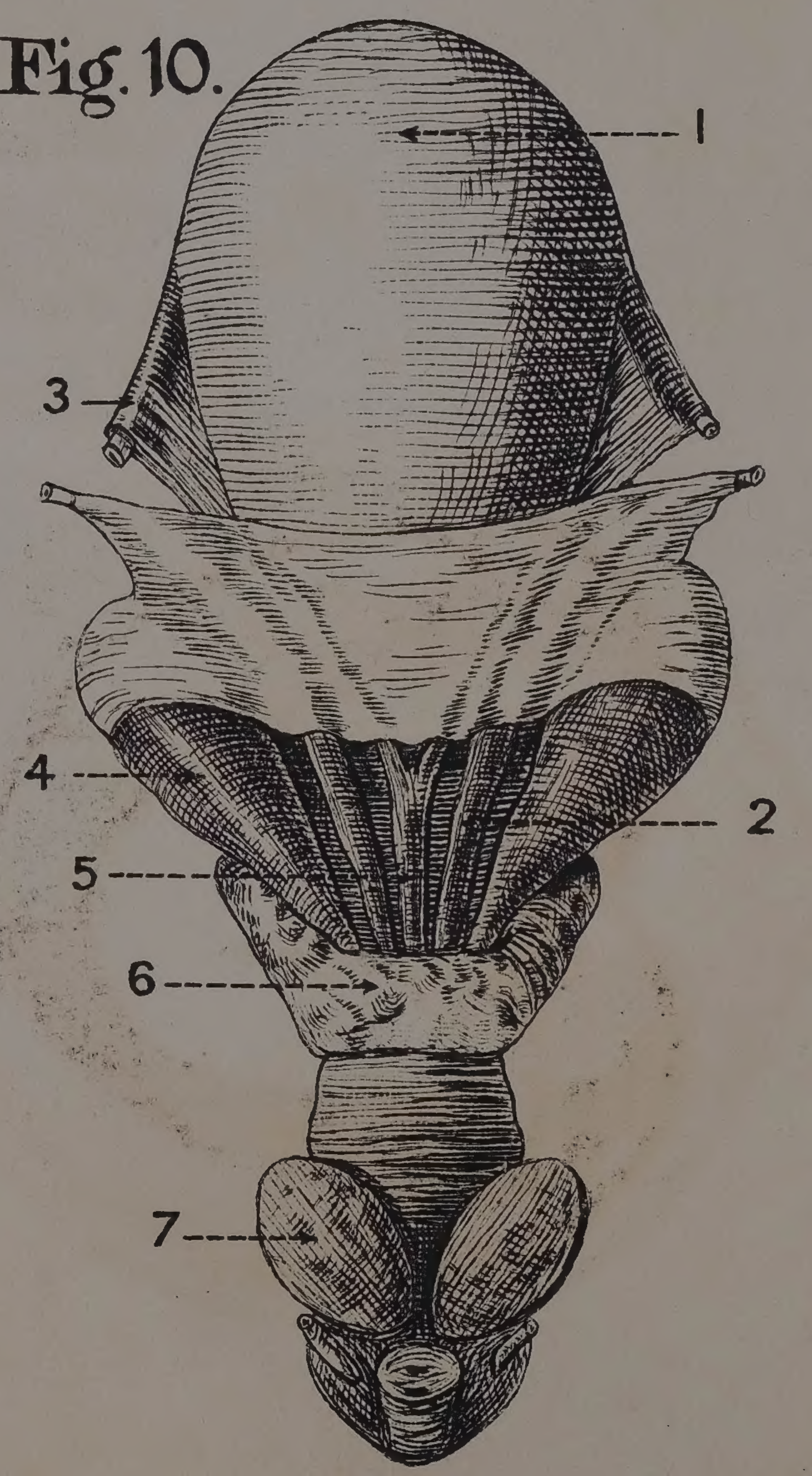

Fig. 11.

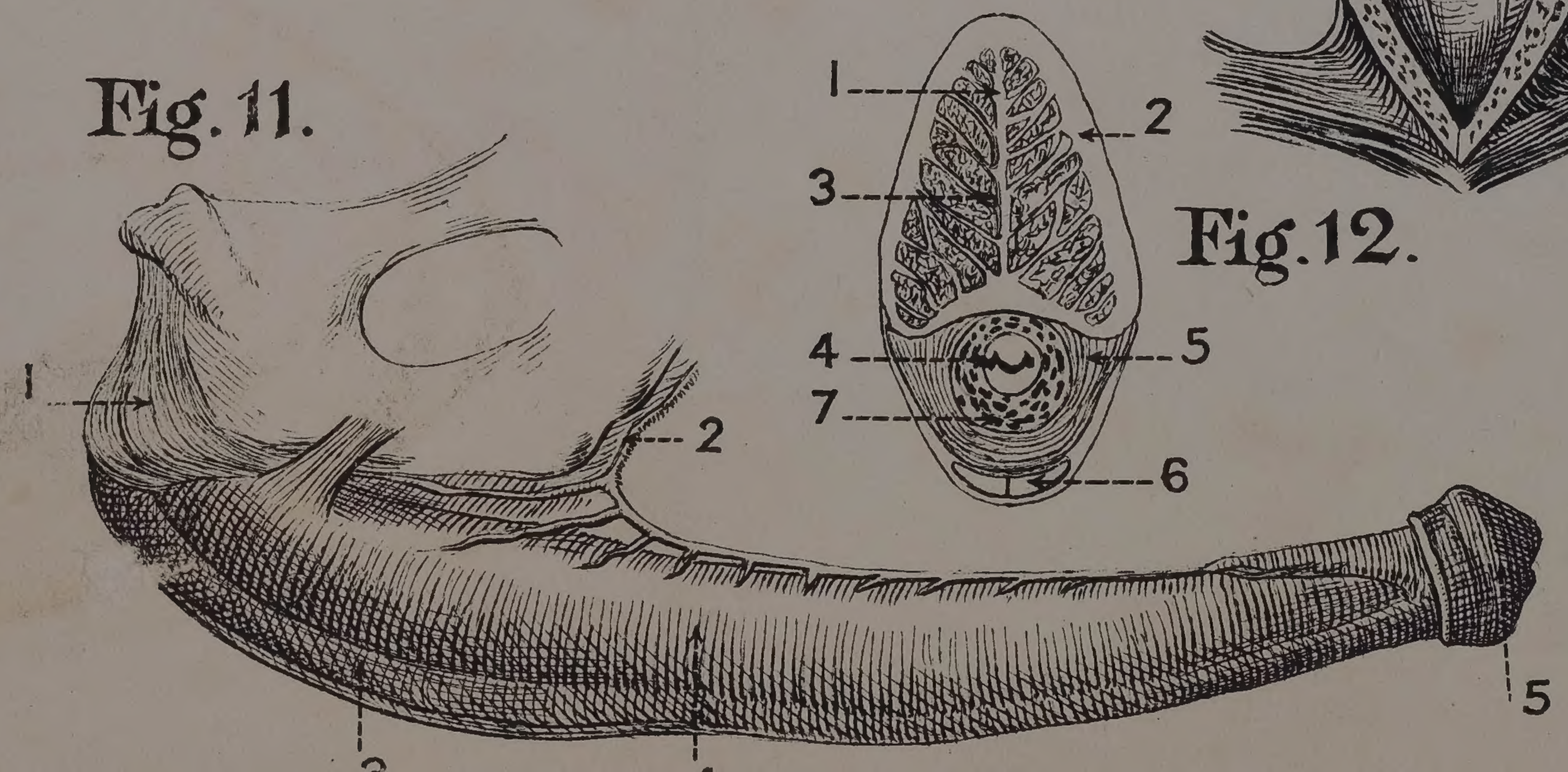

Fig. 12.

Plate C.


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.

Plate II.

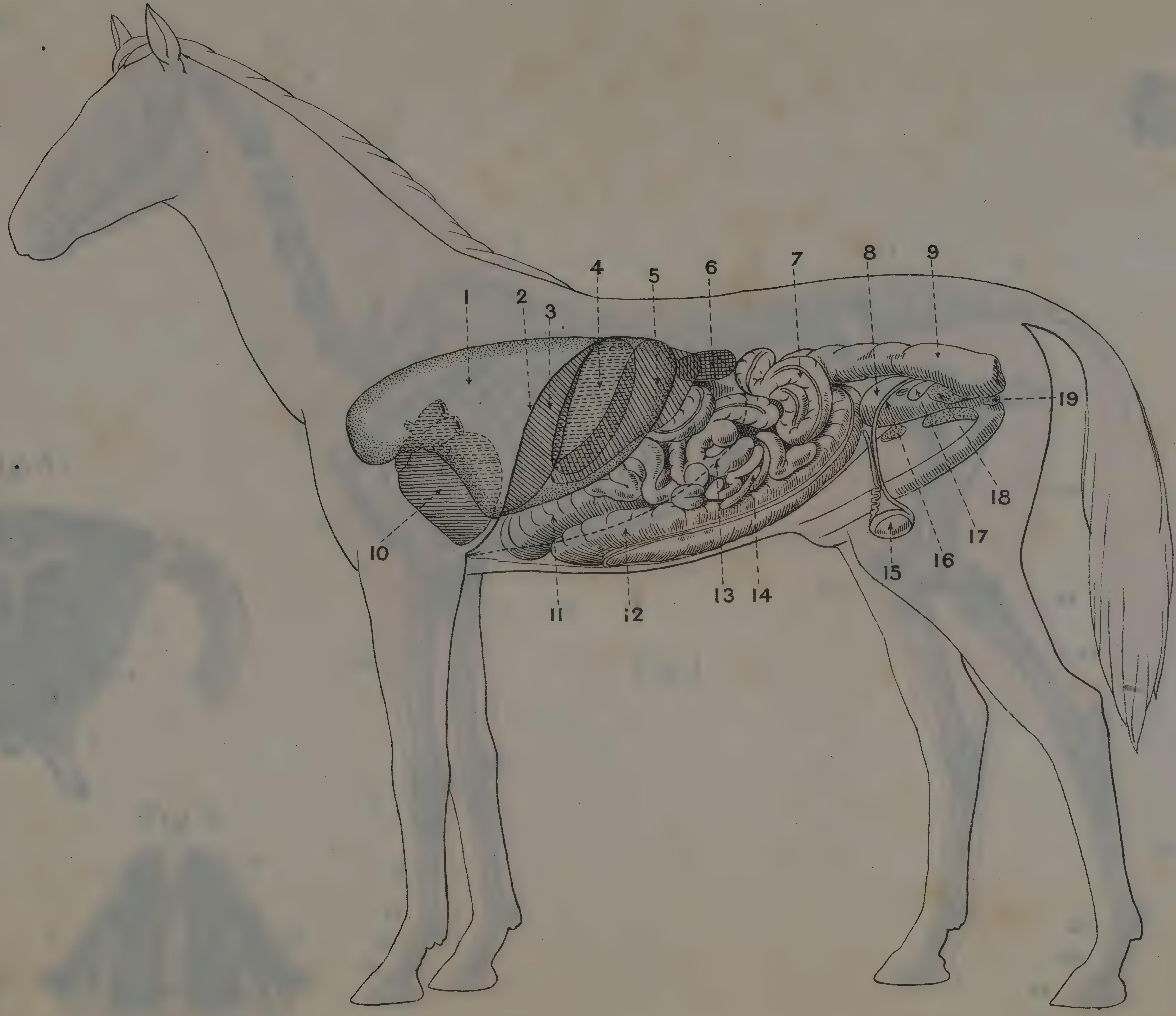


Fig. 1.
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14
15
16
17
18
19
20
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23
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25
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27
28
29
Fig. 2.
1
2
3
4
5
6
7
8
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10
Fig. 3.
1
2
3
4
5
6
Fig. 4.
1
2
3
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5
6
Fig. 5.
1
2
3
4
5
Fig. 6.
1
2
3
4
5
6
7
8
9
10
11
Fig. 7.
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2
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4
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6
Fig. 8.
1
2
3
4
5
6
7

Plate IV.

Fig. 2.

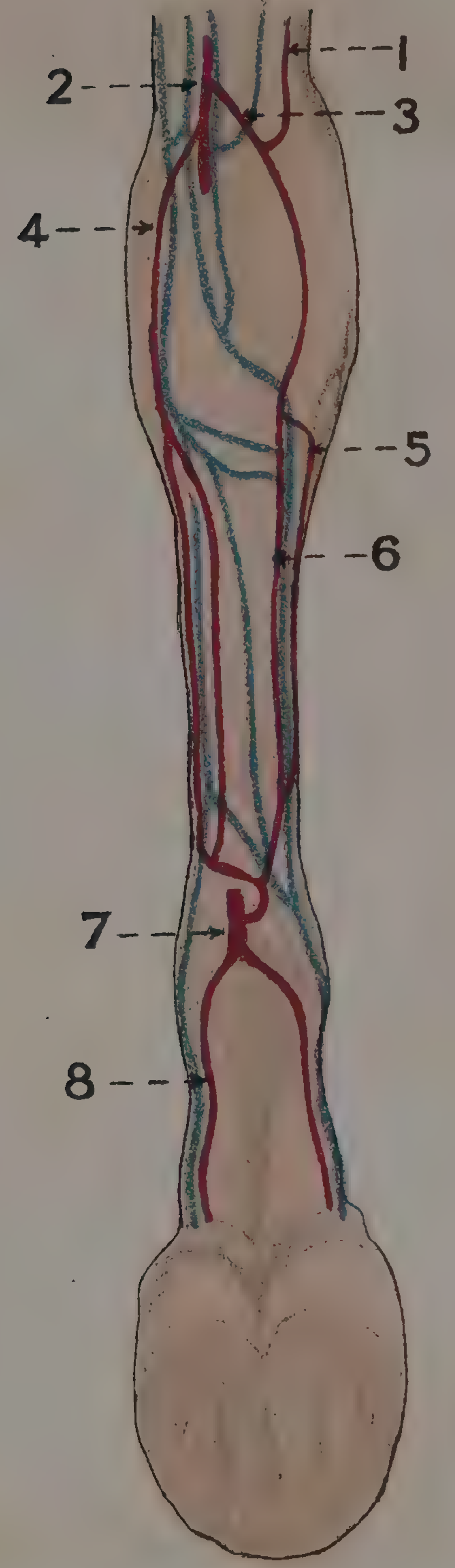


Fig. 1.

Fig. 5.

Fig. 4.

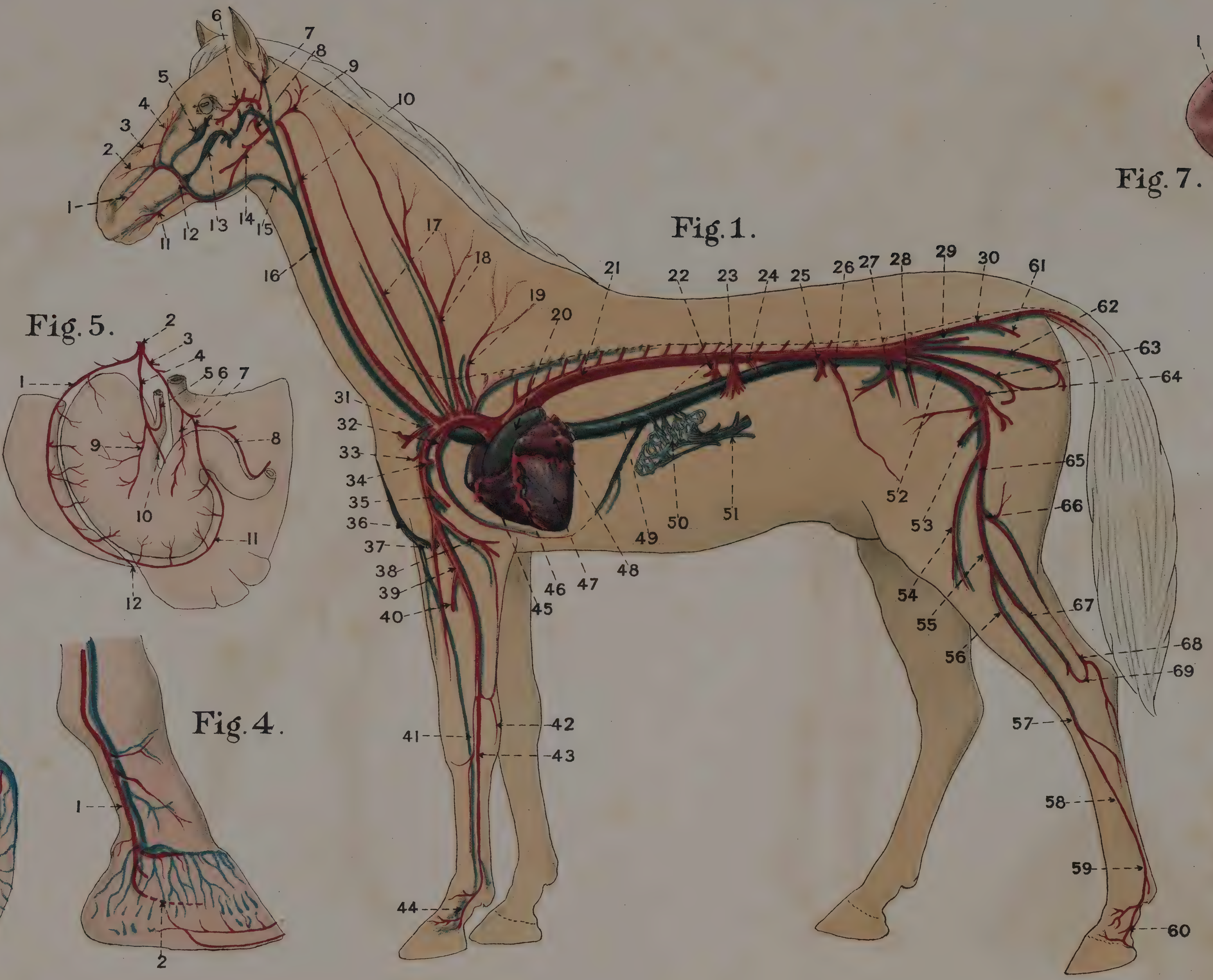


Fig. 7.

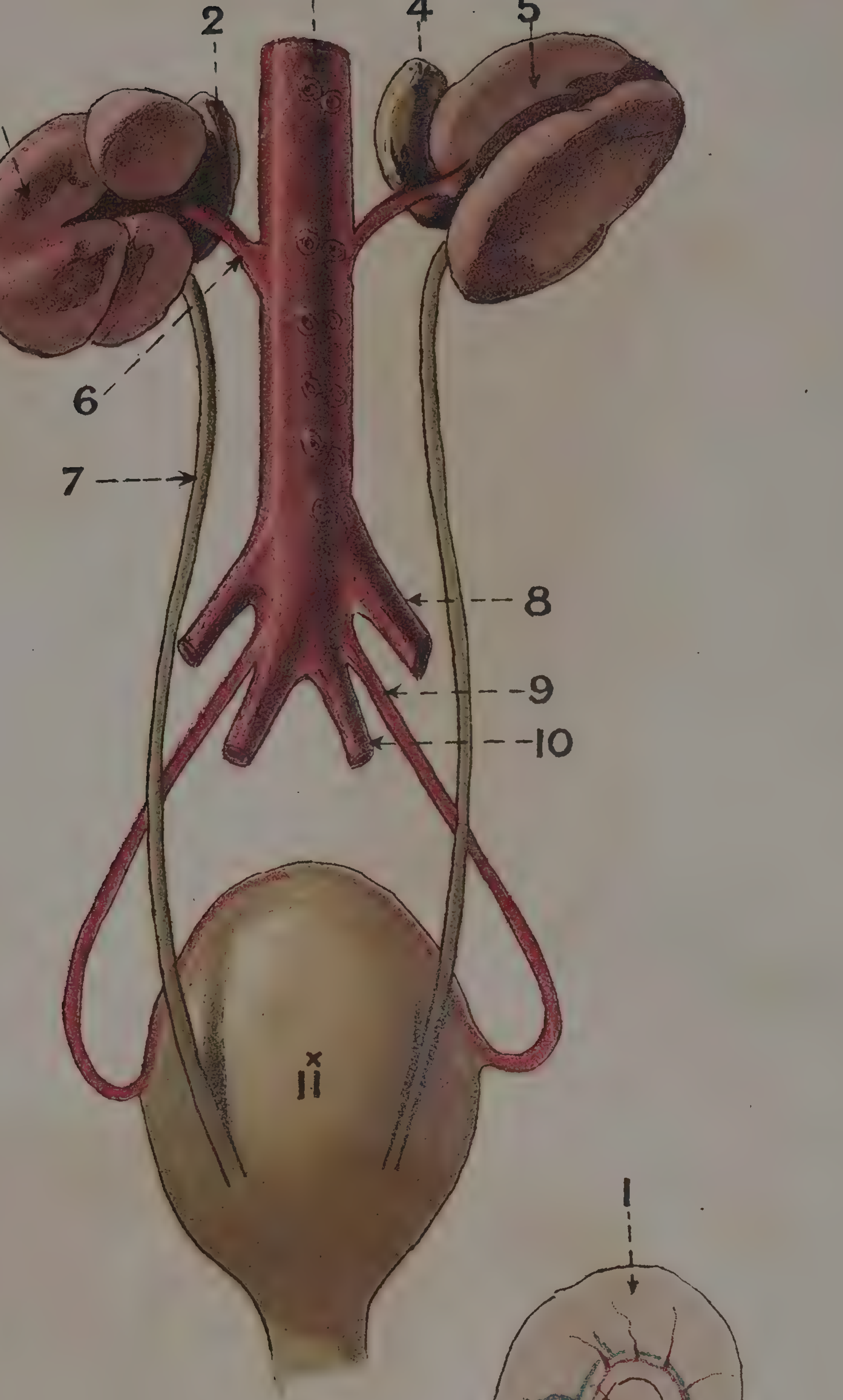


Fig. 3.

Fig. 6.

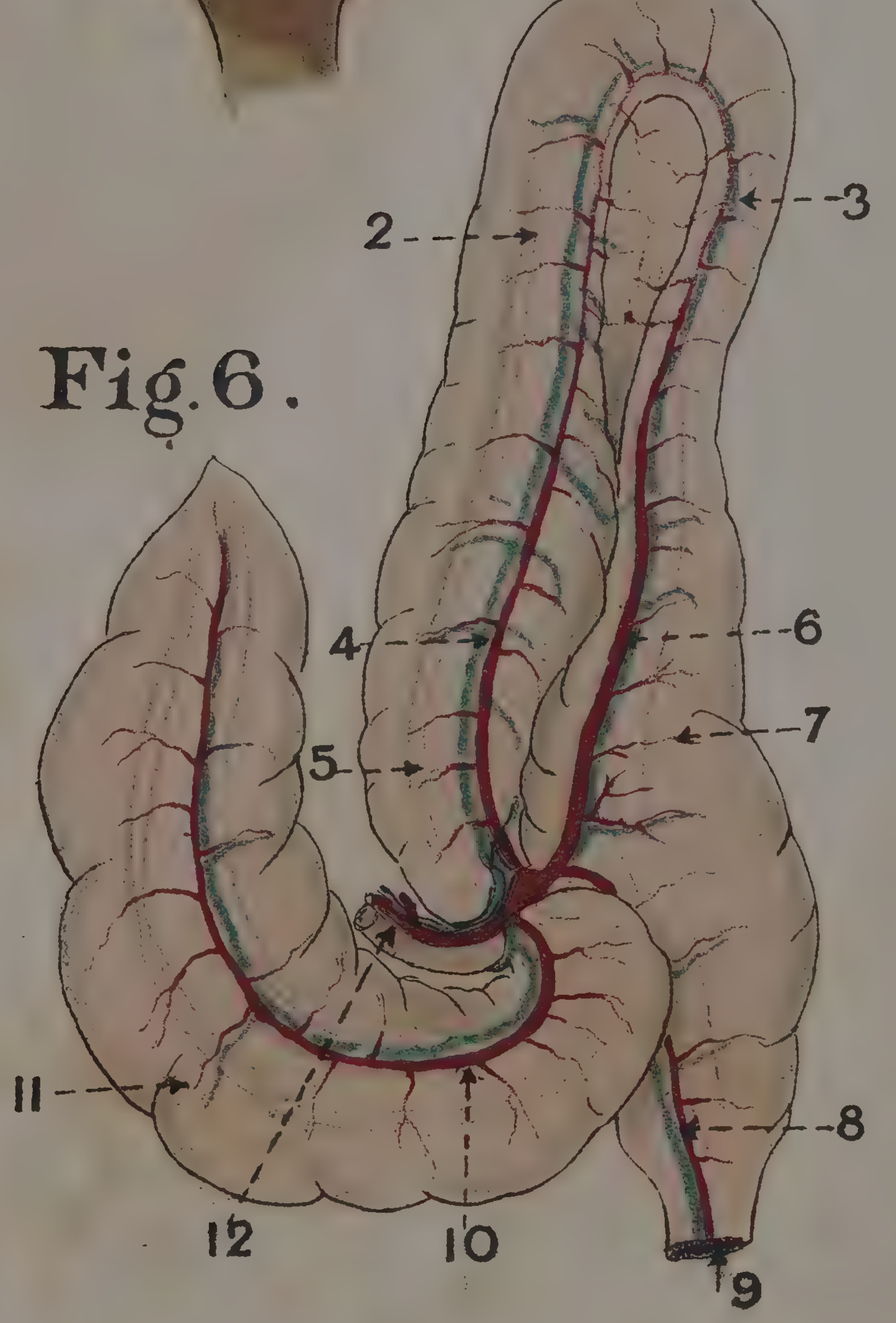


Plate D.

Fig. 1.

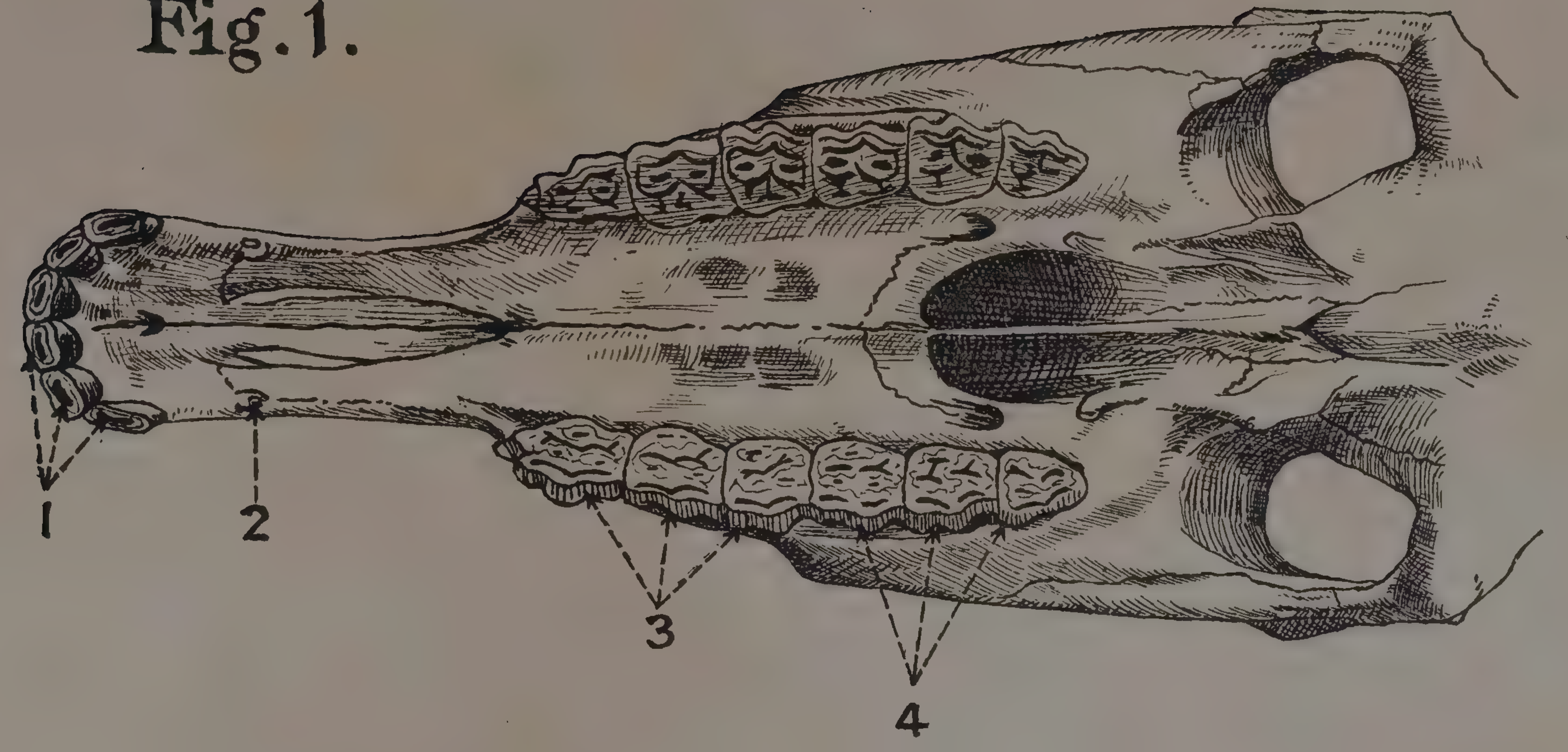


Fig. 6.

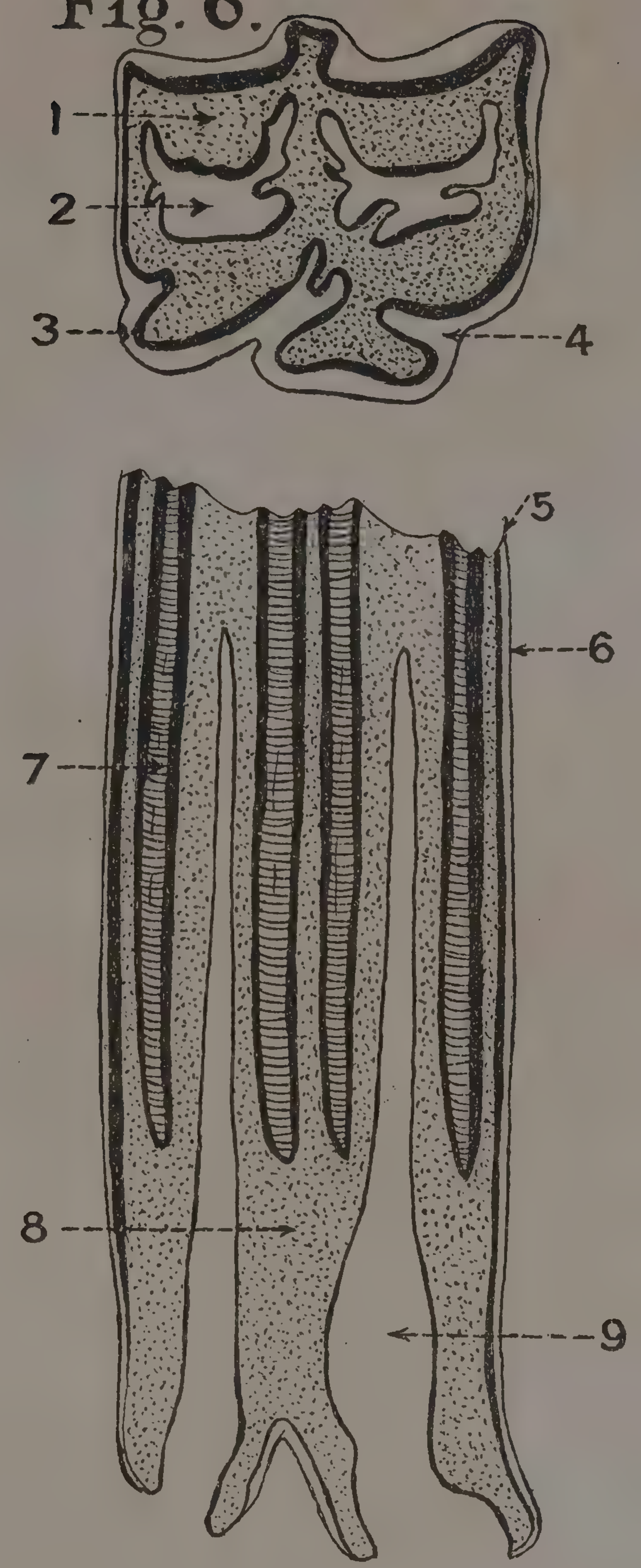


Fig. 9.

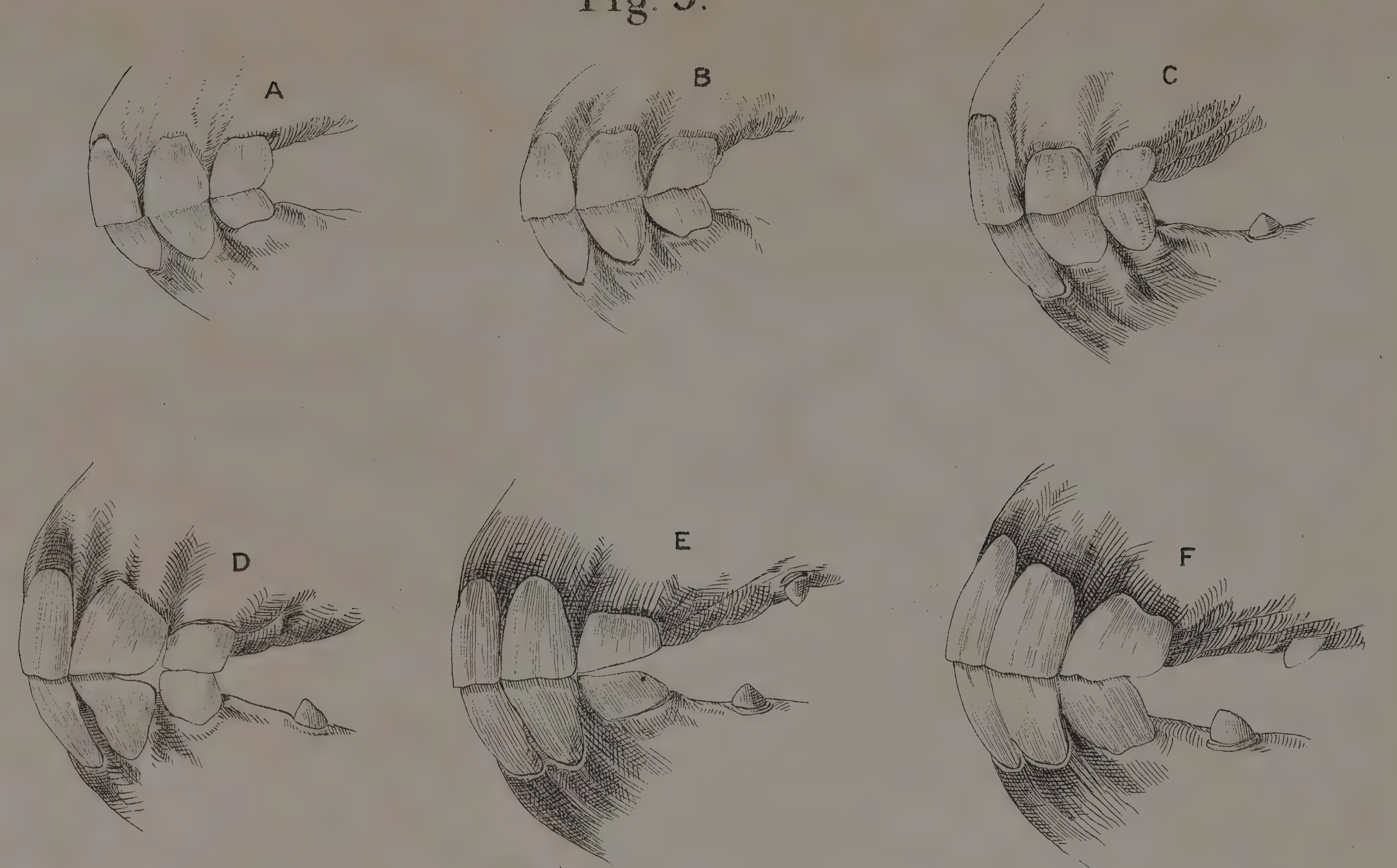


Fig. 2

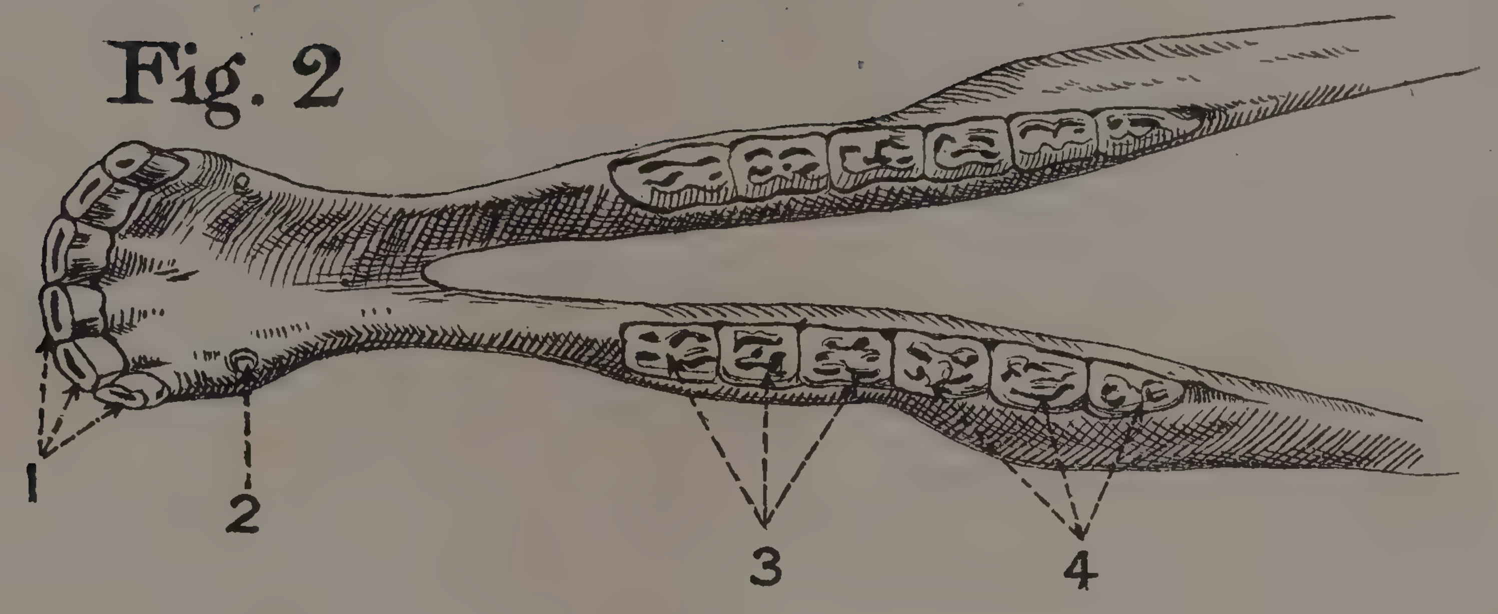


Fig. 4

Fig. 5.

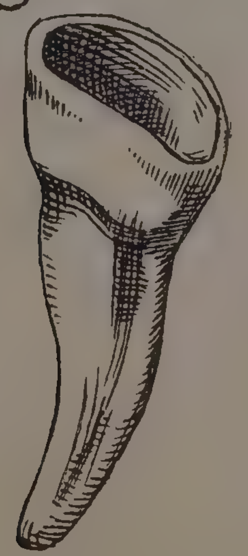
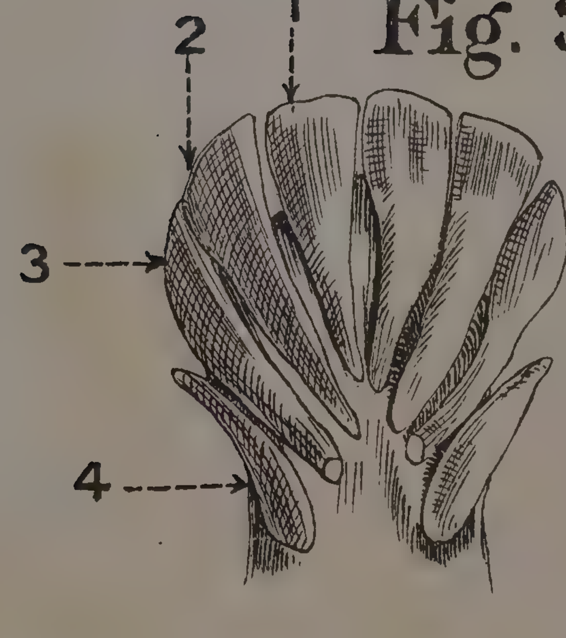


Fig. 3.



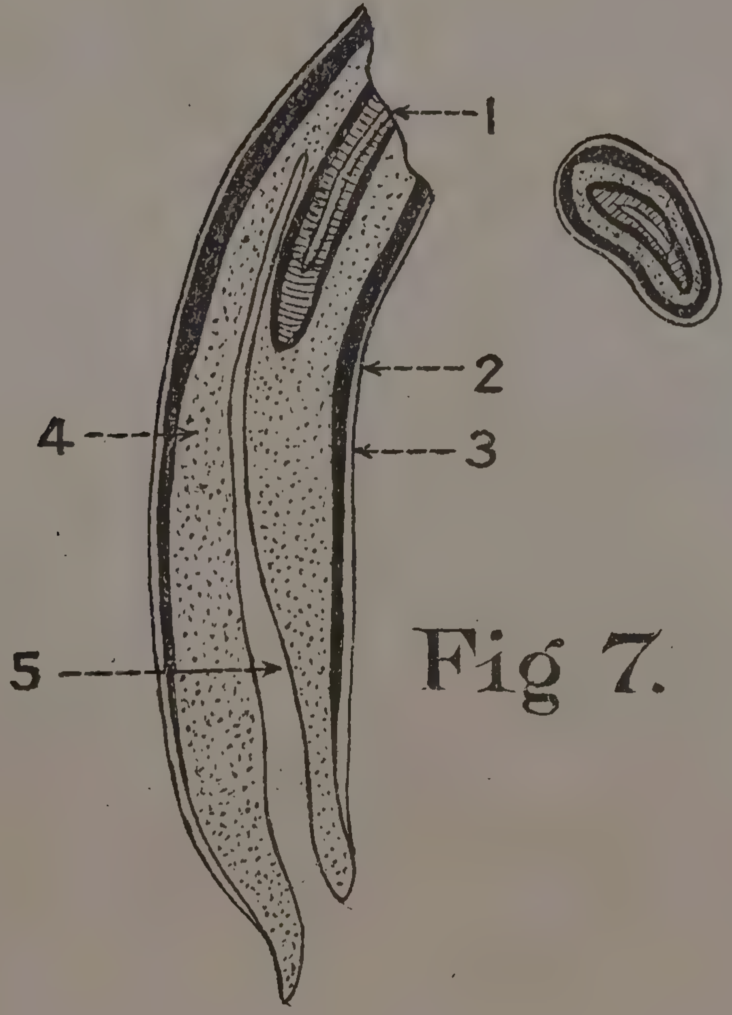


Fig 7.

Fig. 8.

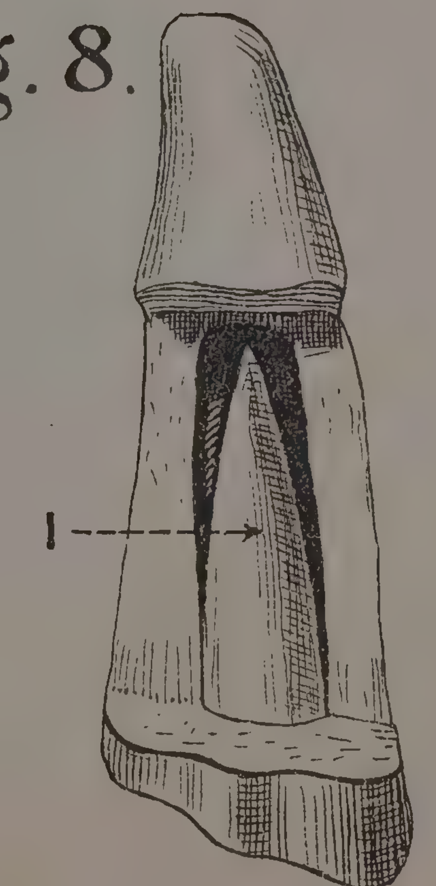


Plate E.

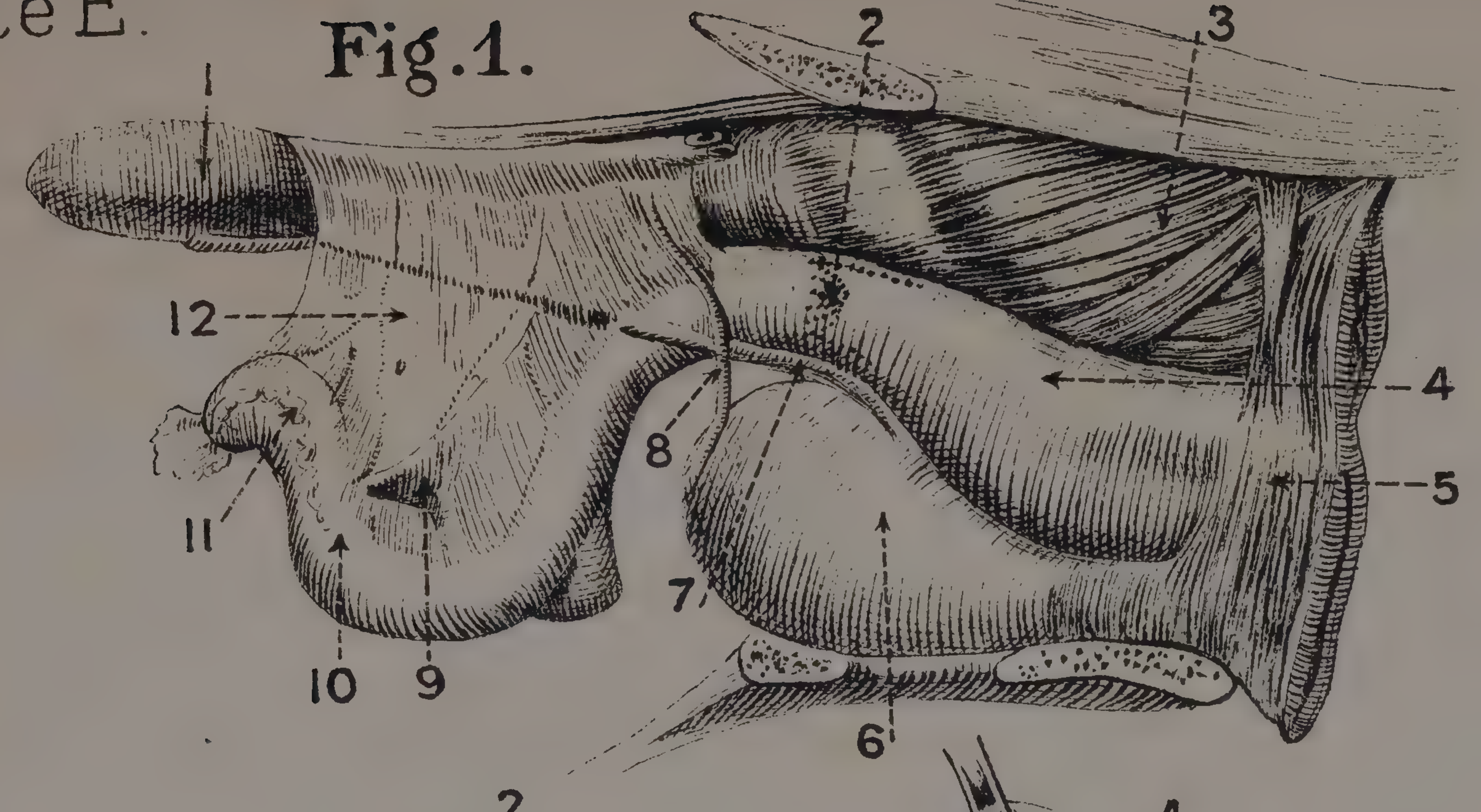


Fig. 1.

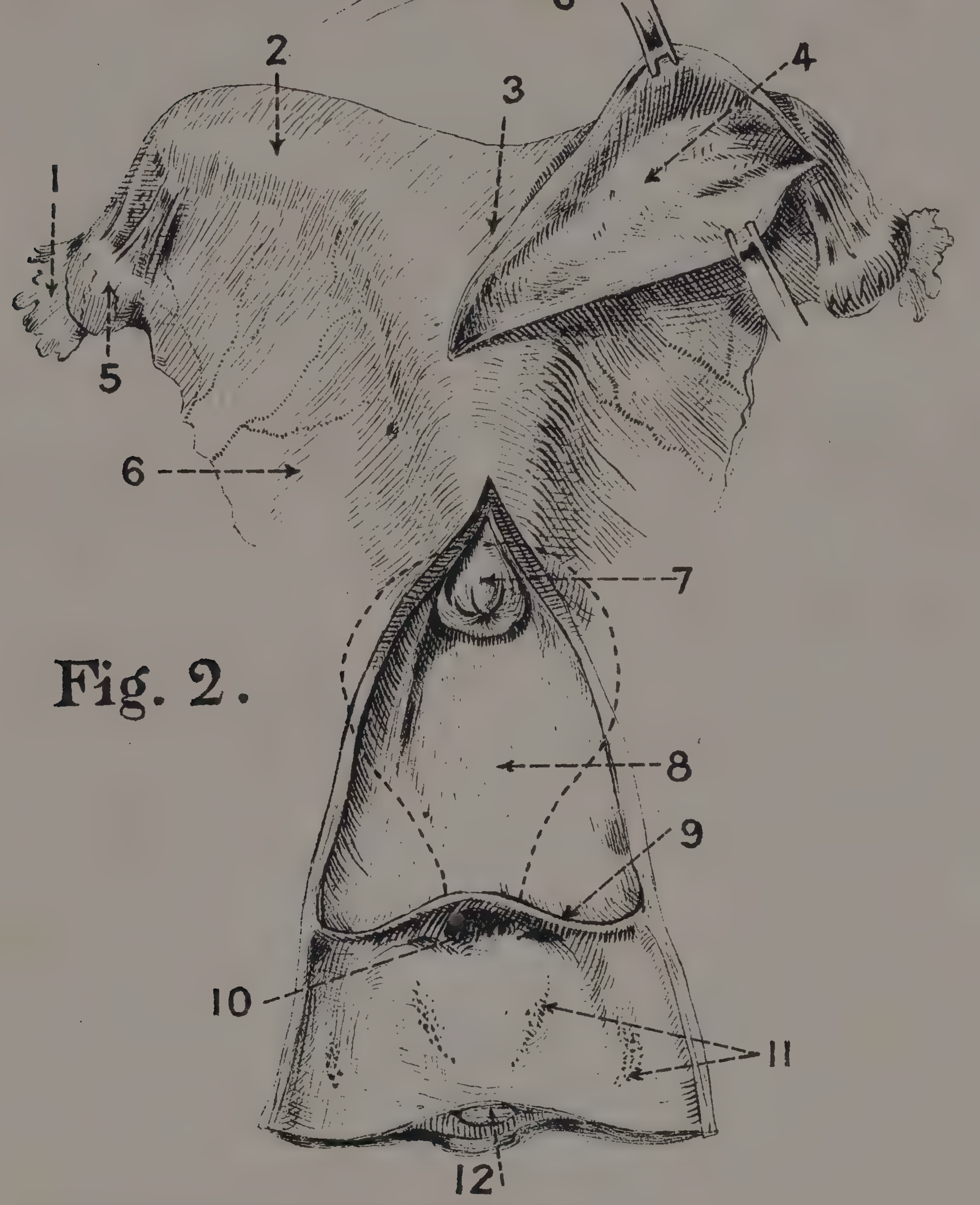
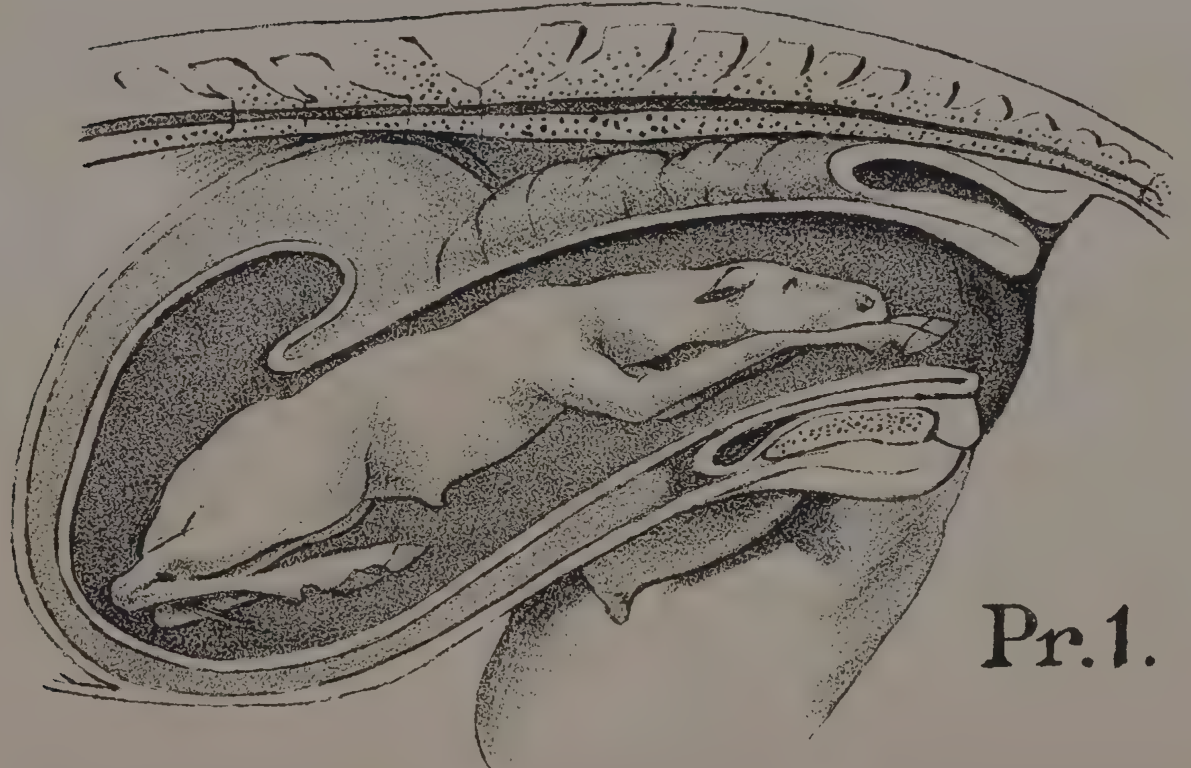
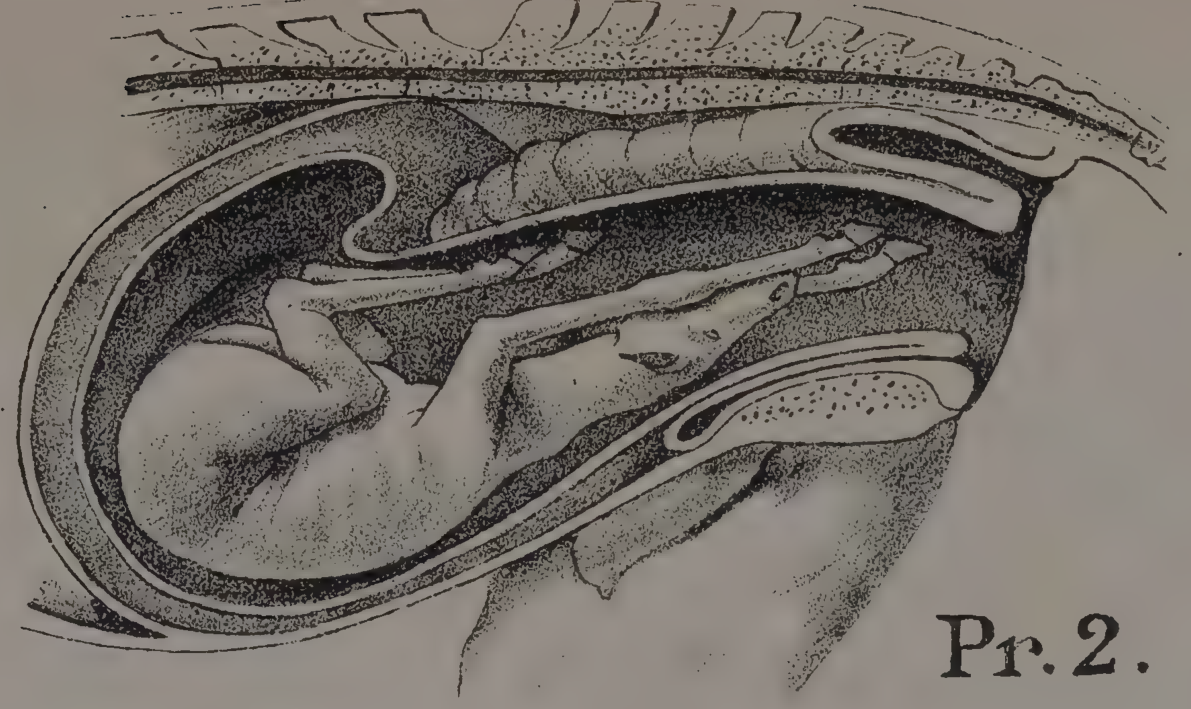


Fig. 2.



Pr. 1.



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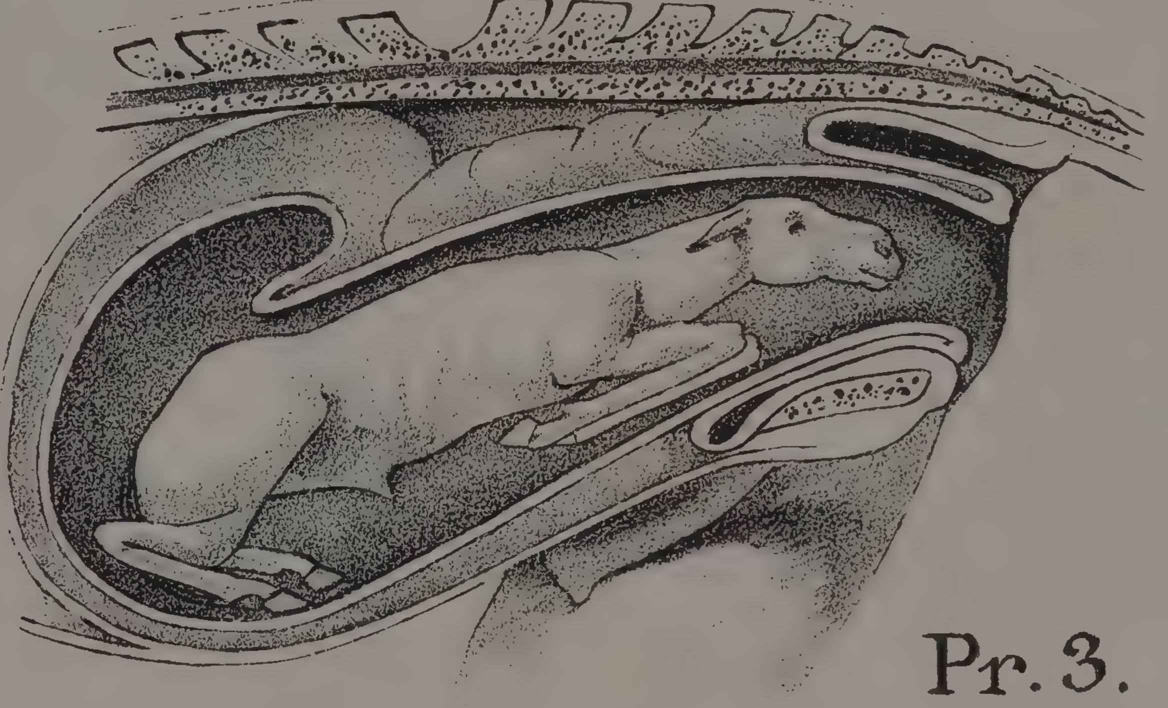
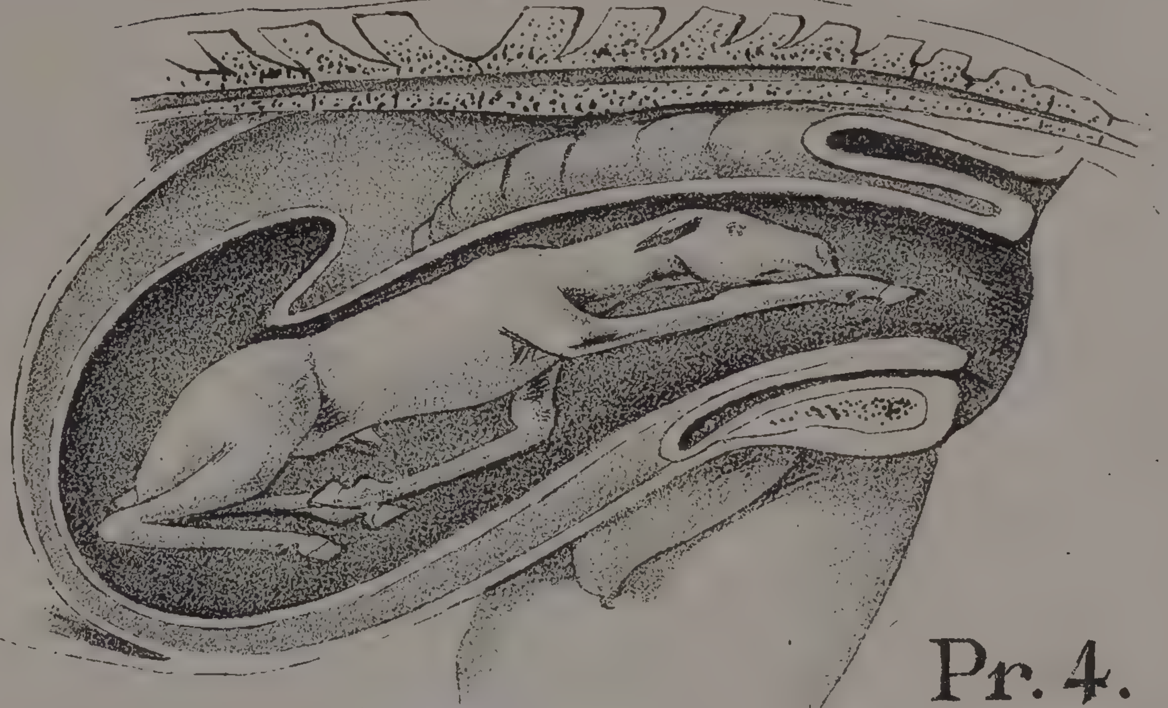


Pr. 3.



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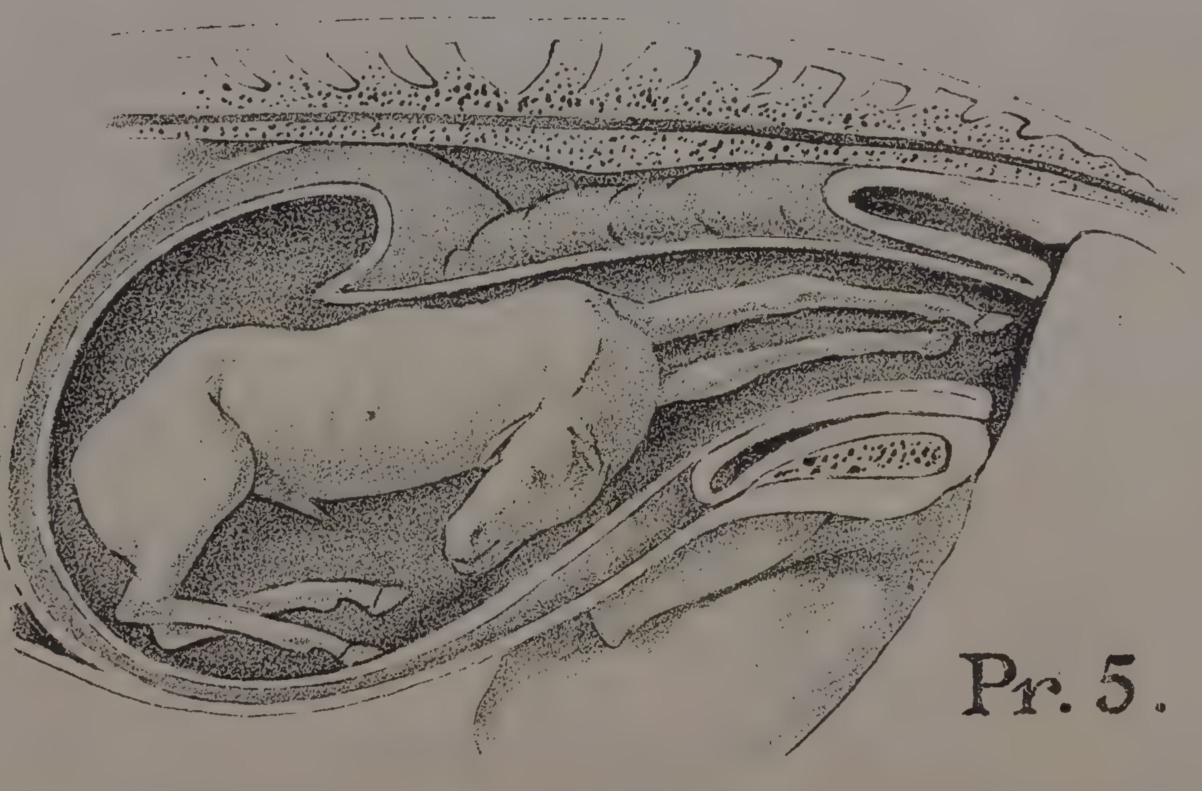

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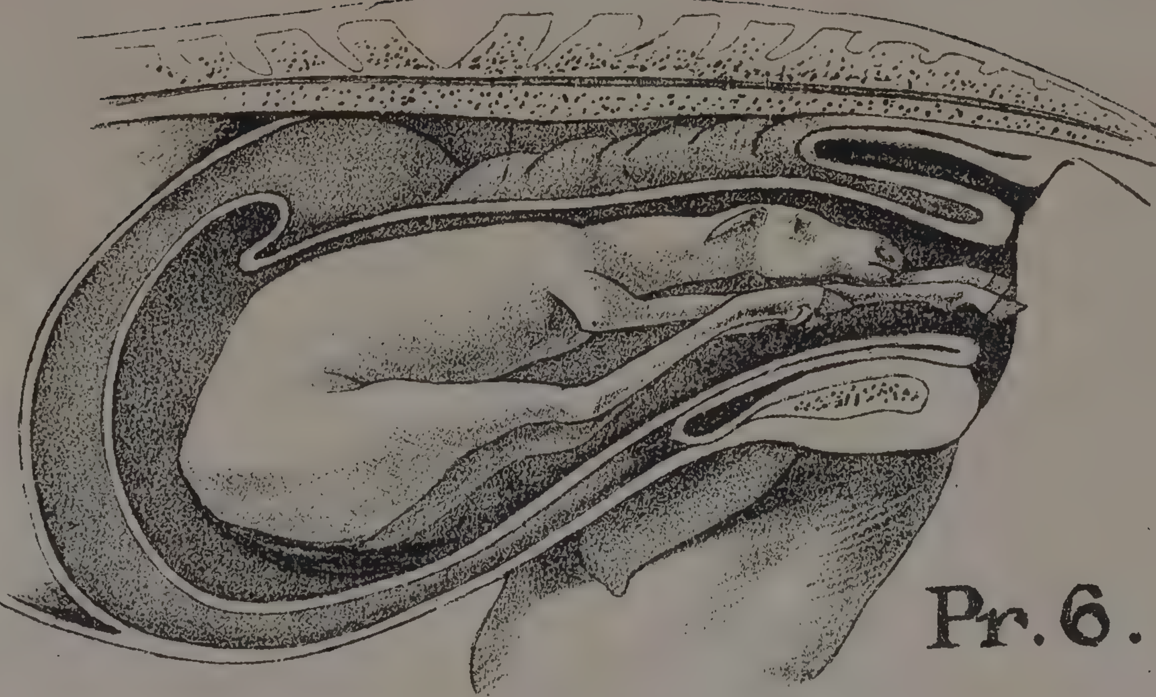

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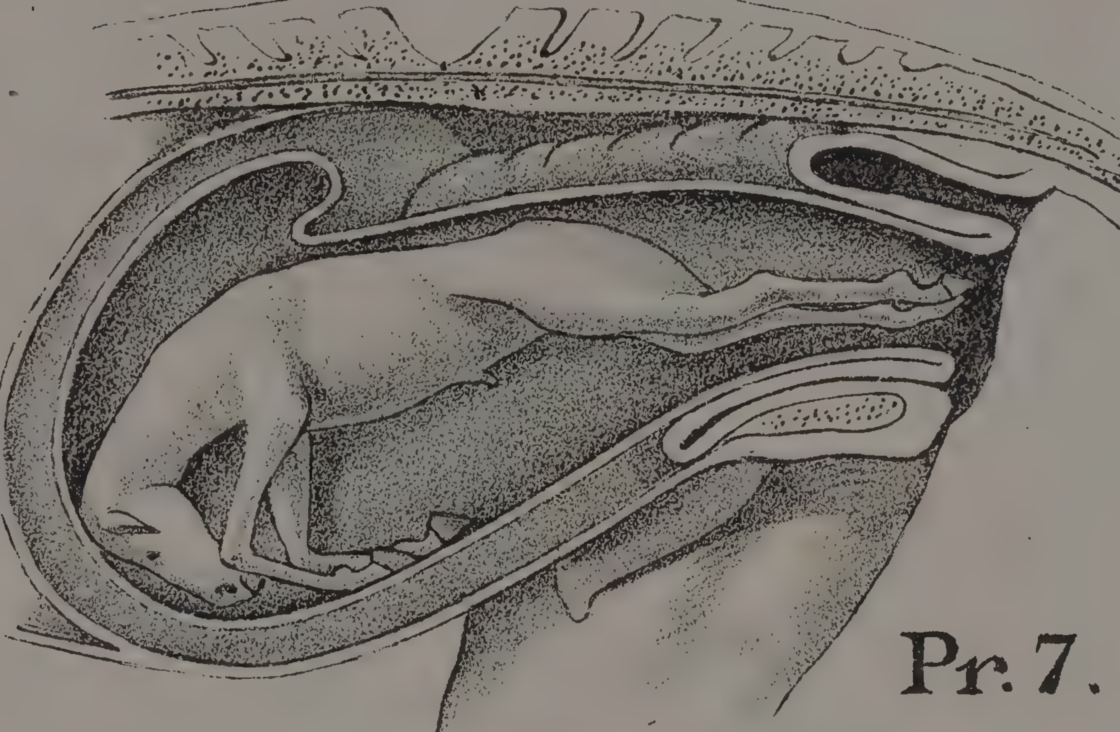

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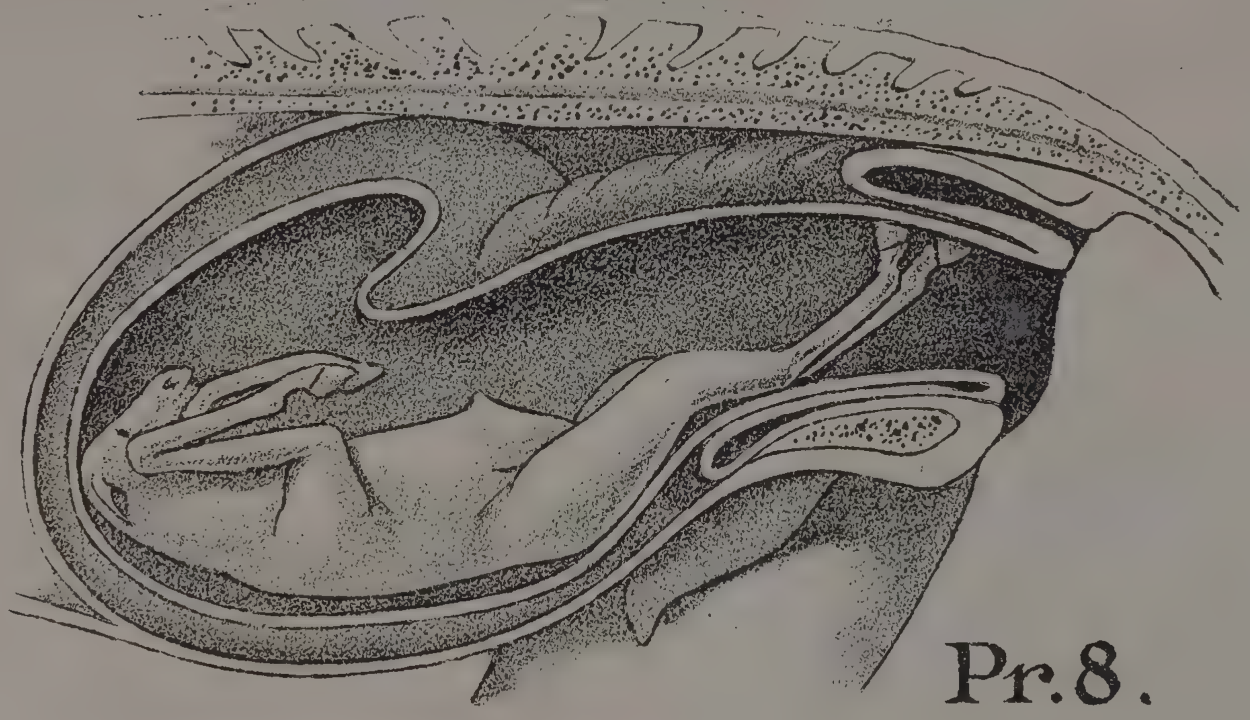

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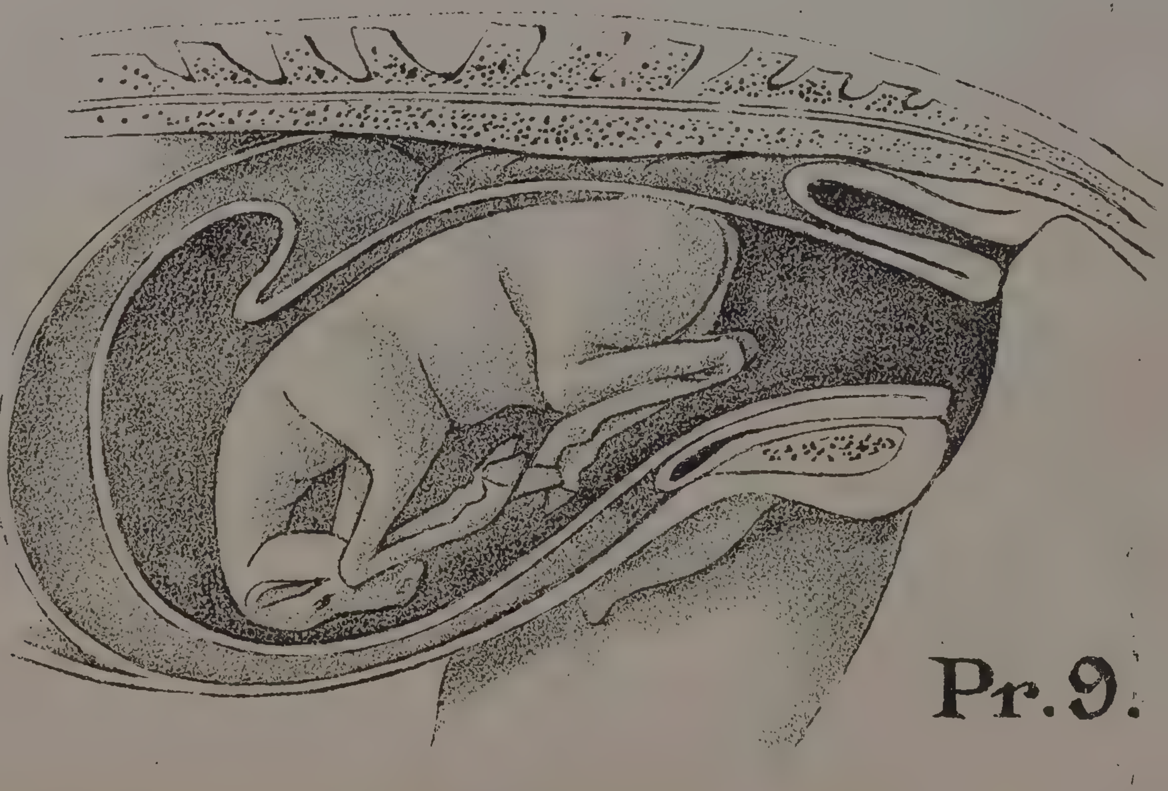

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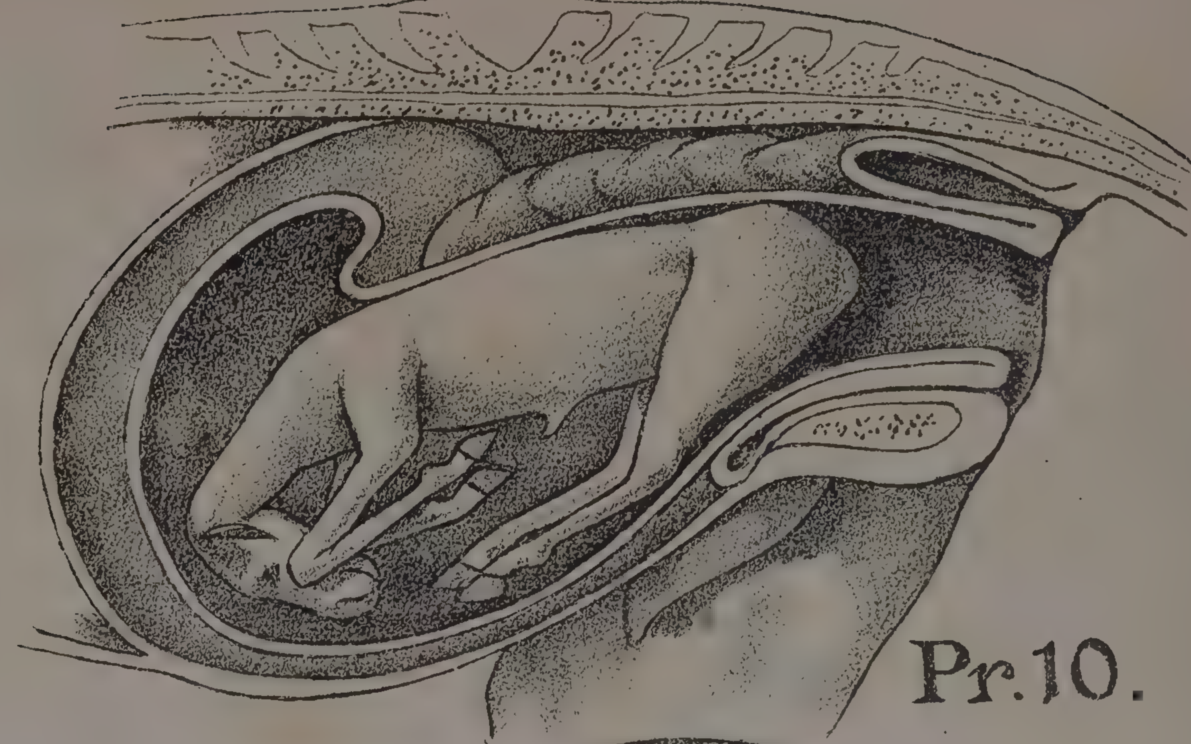

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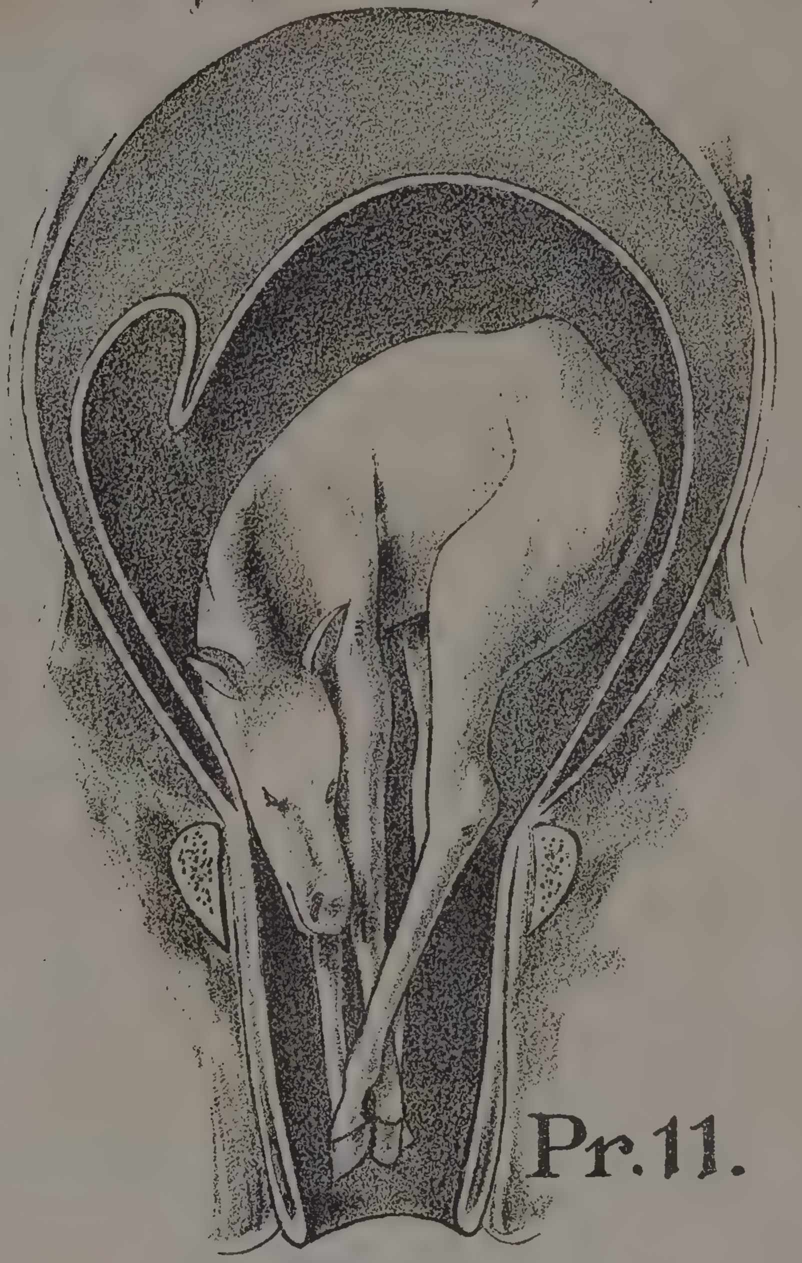
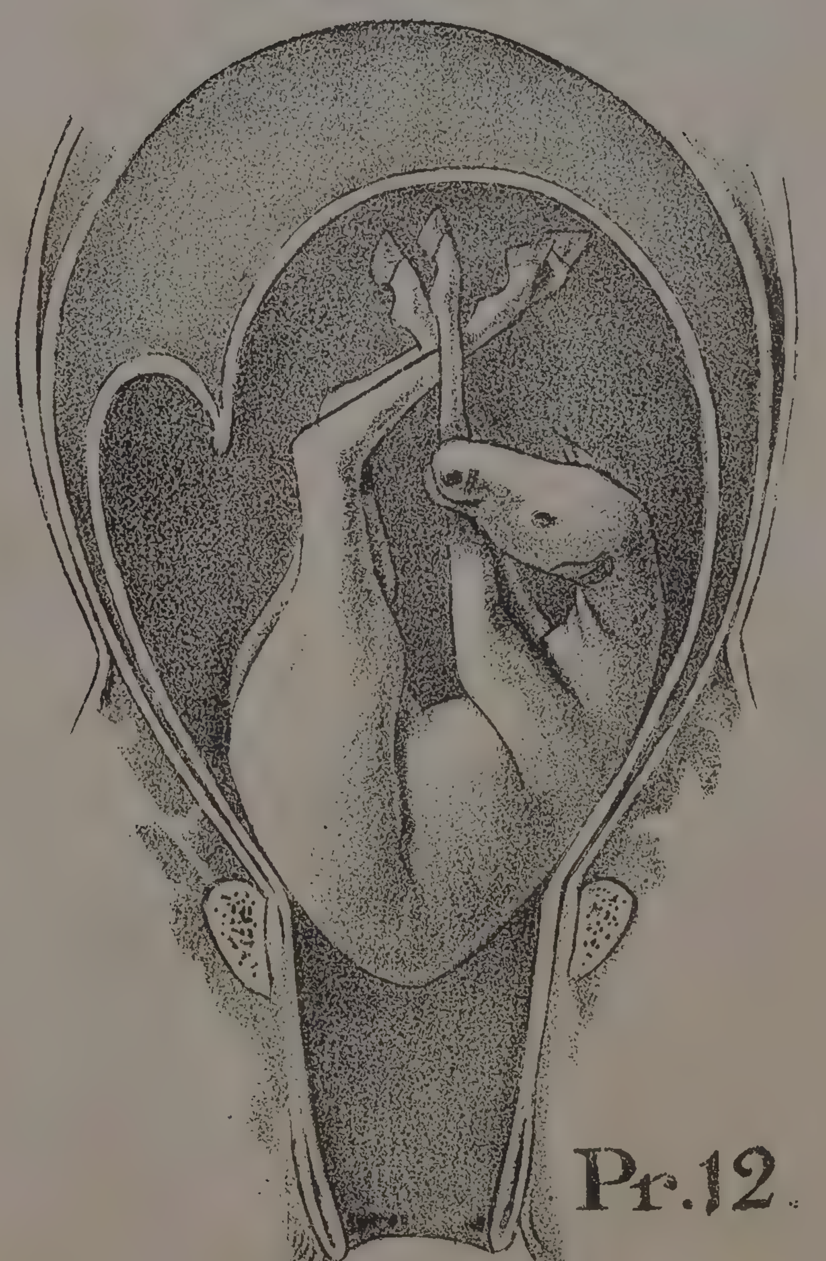


Pr. 11.



Pr. 12.

Plate V.

Fig. 2.

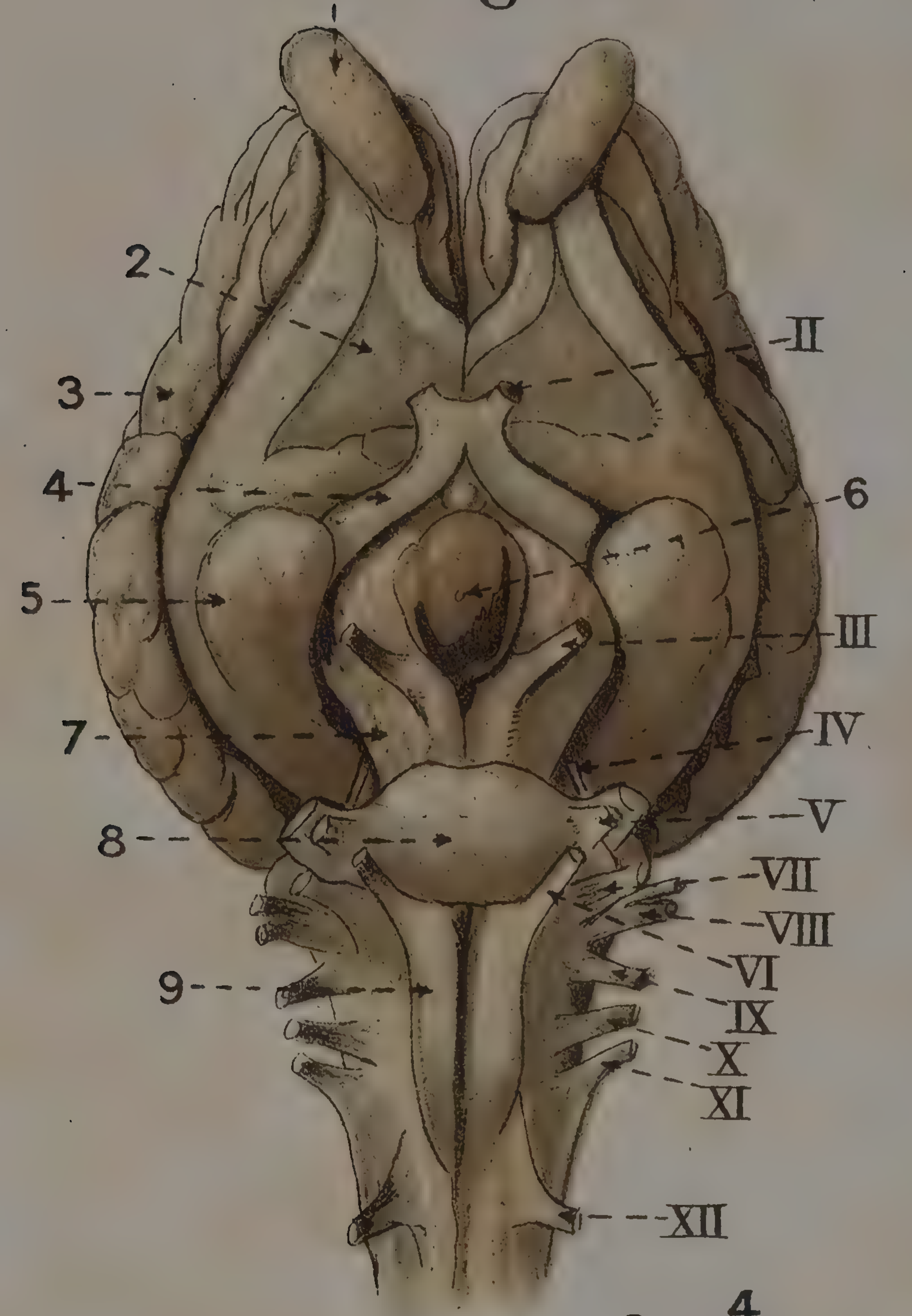


Fig. 3.

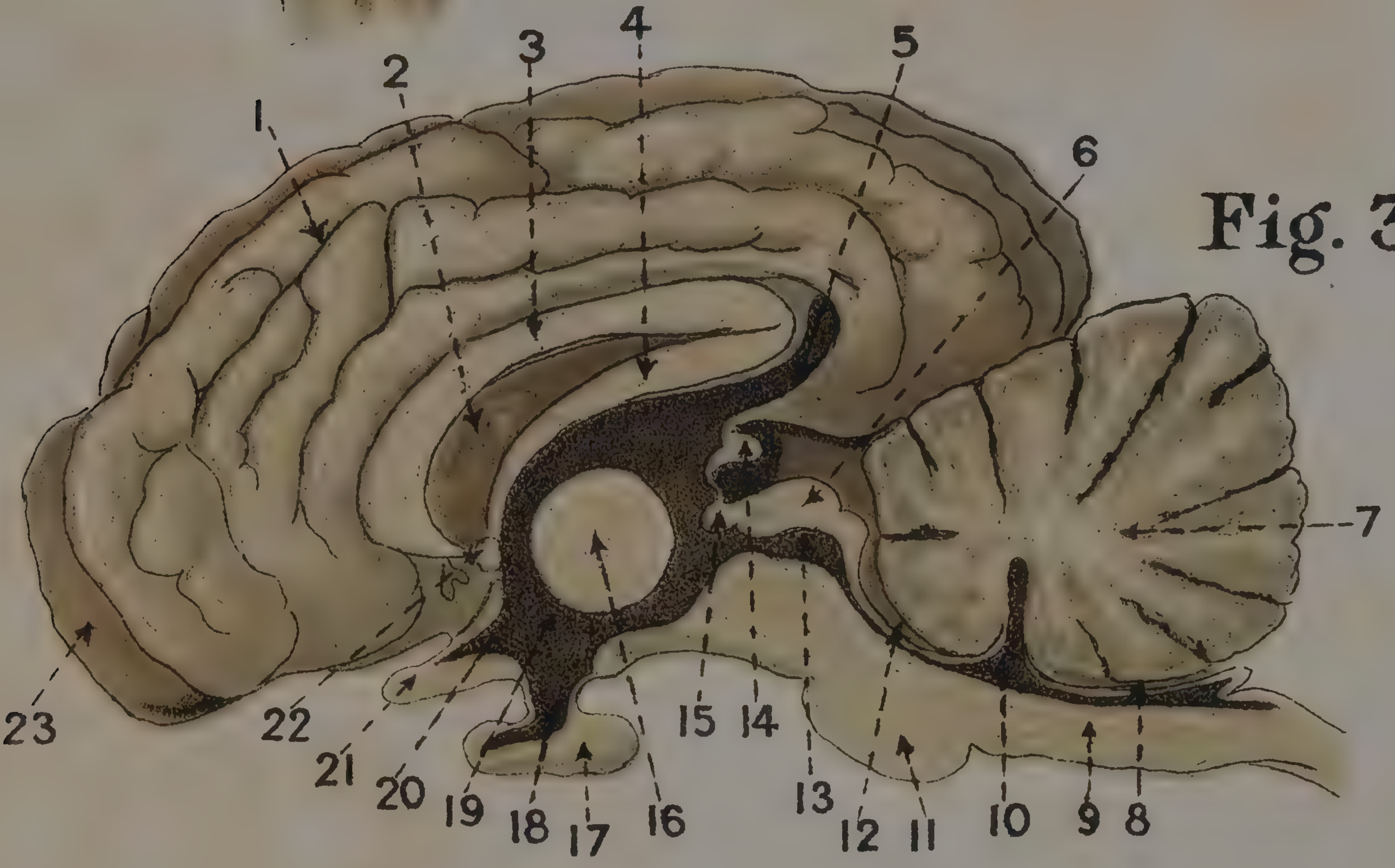


Fig. 1.

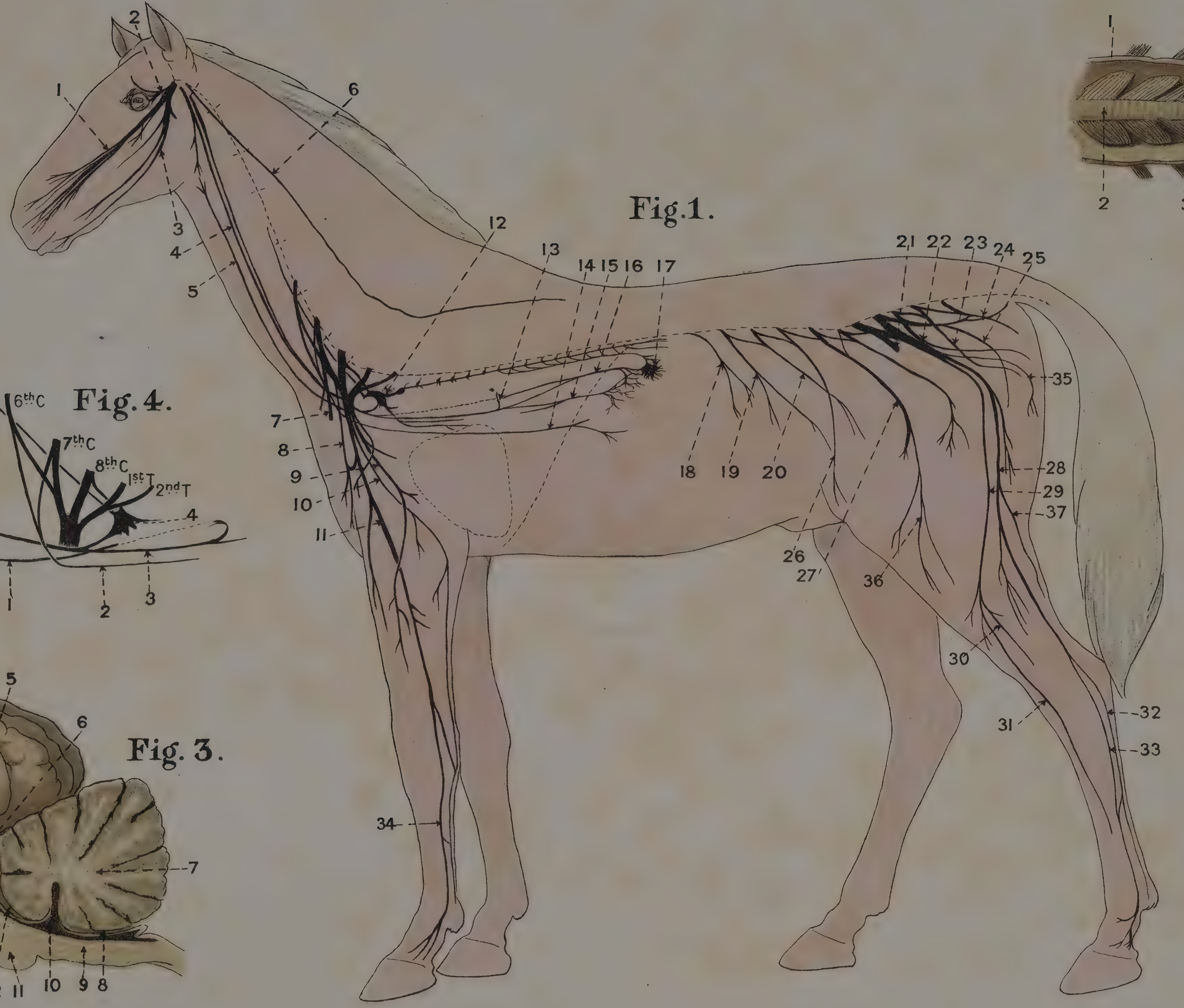


Fig. 4.

Fig. 5.

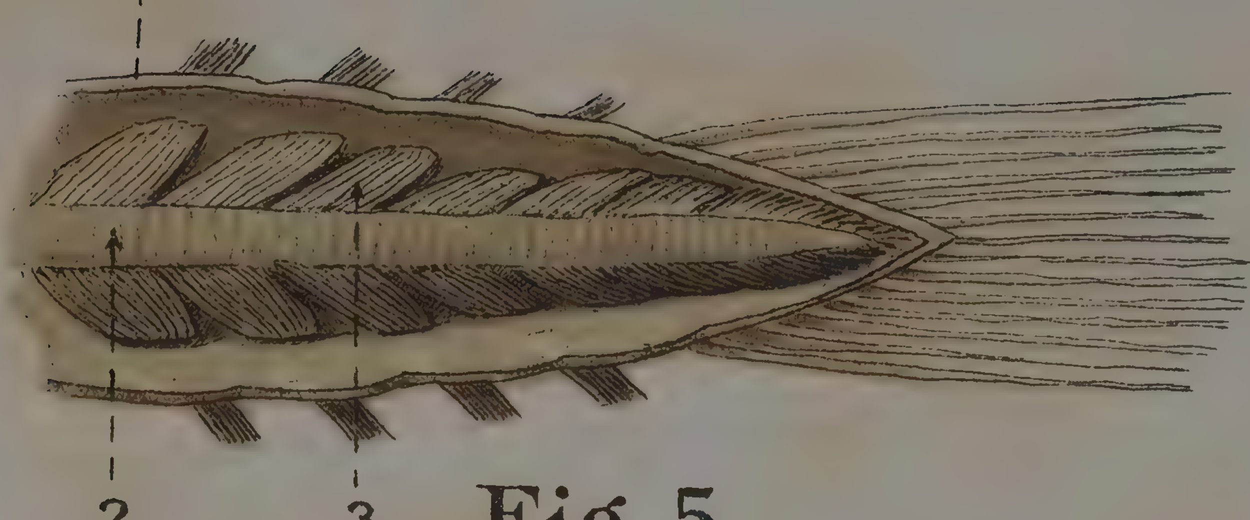


Fig. 6.

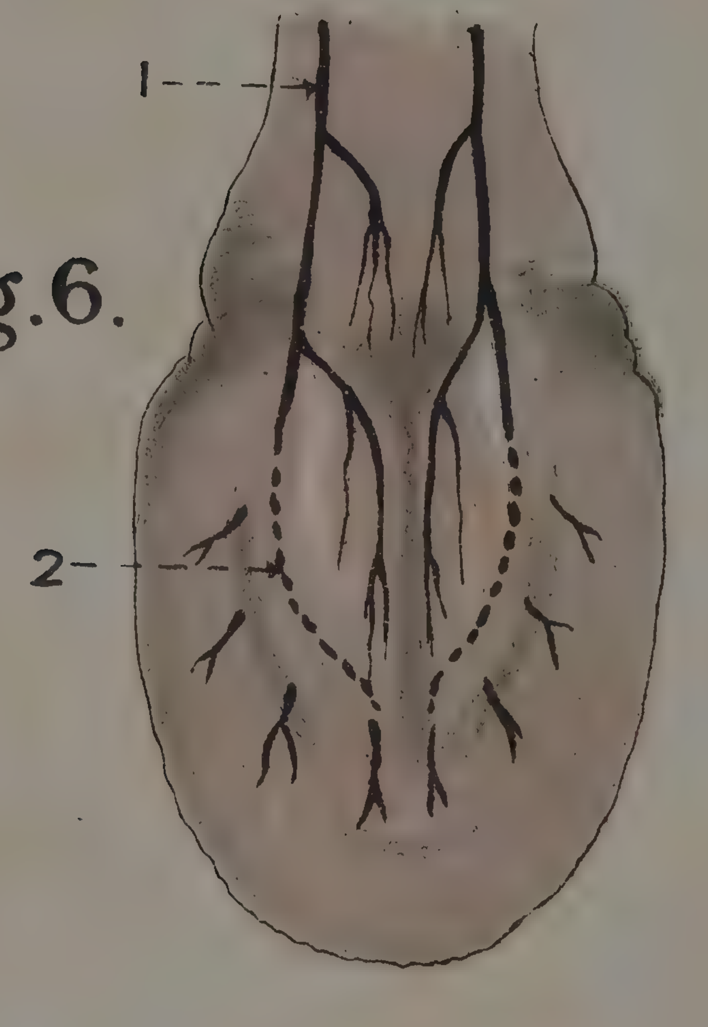
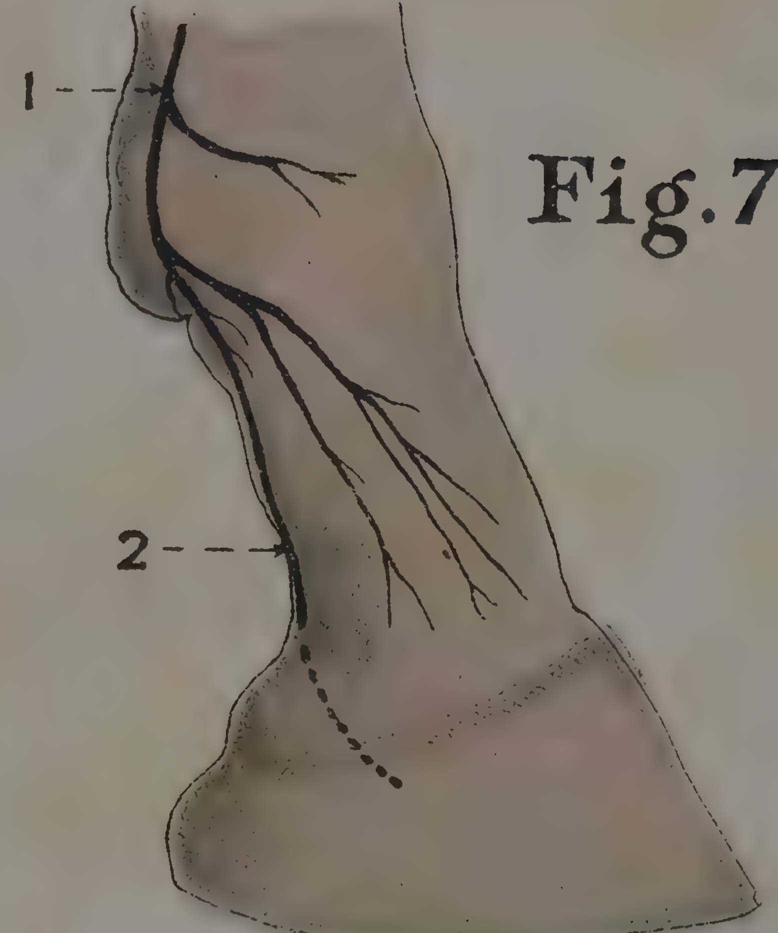


Fig. 7.



350.-

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WITH ORIGINAL PLATES BY

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CONTENTS

MENS·SANA·IN·CORPORE·SANO·

LONDON: BAILLIÈRE, TINDALL & COX, 8, HENRIETTA STREET, COVENT GARDEN, W.C. 2

1918

TEXT TO ATLAS

OF THE

ANATOMY AND PHYSIOLOGY OF THE HORSE

INTRODUCTORY.

It is probably safe to say that no mammal presents more interesting structural peculiarities than does the horse. Some of these are scarcely susceptible of reasonable explanation, but others are unquestionably evidence of the evolutionary history of the animal as we know him to-day.

The alimentary system presents features of surpassing interest. As is well known, the teeth of the horse have peculiarities which clearly distinguish them from those of mammals within even a short zoological distance. In all the teeth, with the exception of the canines, size is an outstanding peculiarity; but along with this must be noted a complexity of design, the gradual development of which is one of the conspicuous facts of the evolution of the modern horse. A cursory examination of the unworn tooth of a horse is sufficient to reveal the circumstance that the surface opposed to the tooth in the opposite jaw is uneven. This unevenness is produced by a folding of the enamel, which, in the cheek-teeth, reaches a considerable distance towards the tip of the root of the tooth. The folding is fairly simple in the incisor teeth, where it dips downwards into a funnel-shaped depression—the infundibulum. In the cheek-teeth it is so complex as to give one the impression that a certain amount of pressure had at some time been applied to the tooth, in such a manner as to cause a crinkling of the enamel folds.

In view of what is known of the anatomy of the ancestors of the modern horse, there can be little question that the folding of the enamel of the teeth is one of the products of evolution. In the earliest known ancestors the folds were trifling as compared with those we see to-day.

Another feature of the horse's teeth, which is of interest to both the anatomist and the surgeon, is not unknown in a considerable number of mammals. Reference is here made to the fact that the pulp in the interior of the teeth does not disappear when the animal attains the adult state, but persists for a number of years thereafter. So long as tooth pulp is present the tooth is capable of growth. Continued growth, accompanied by continuous wear, is responsible for those changes in form and appearance which the teeth of the horse undergo with the passage of the years—a change made use of in the estimation of the age of the horse. From the surgical point of view, the continued growth of the teeth is of some moment, inasmuch as, if a tooth is not subjected to wear by friction against an opposed tooth, its length becomes such as to interfere with mastication, and artificial removal of the inconvenient growth has to be resorted to.

Of all the teeth, the least conspicuous, but of the greatest interest to the evolutionist, is the rudimentary first premolar (generally known as the "wolf-tooth"). There can be little doubt that this tooth is in process of disappearance, a fact indicated by its small and variable size, simplicity of form, and inconstancy of presence.

While the peculiarities of the teeth are readily explained by the evidence of fossil remains, characteristic features of the stomach and intestines cannot be so easily accounted for. The horse being an herbivorous animal, it would be reasonable to expect that the stomach should be of a size adapted to deal with considerable quantities of bulky food, even if it were not of complicated form such as is found in some of the other herbivora.

The stomach of the horse, however, is of relatively small size, a fact which may be best brought home to the reader by saying that it is little, if any, bigger than the stomach of the pig. Moreover, not more than half of the interior of the organ is provided with glands by which gastric juice is secreted. As opposed to the small size of the stomach, and undoubtedly acting in a measure as compensation therefore, the large intestine is capacious, and of some degree of complexity in arrangement.

Interesting though the examination of the alimentary and other organs may be, they have to take a very secondary place in this regard when compared with the limbs. As has been clearly demonstrated by palæontology, the horse, during his evolution, has undergone a great increase in size. And as his environment has changed, alterations have taken place in his limbs. The most marked modification has been the gradual diminution in the number of digits, until the irreducible minimum of one has been reached. As the digits became fewer, their relation to the surface of the ground also altered, so that the present-day horse walks on the extreme tip of his solitary finger and solitary toe. In other words, the animal has gradually raised himself to tiptoe. Associated with the reduction in the number of digits and the change of posture, there has been a considerable lengthening of the metacarpal and metatarsal regions of the limbs. This elongation and change of posture can be most readily appreciated by examining a horse alongside an animal—a dog, for example—in which several digits are still present.

Moreover, the reduction in the number of digits has been accompanied by an alteration in the degree of development of the bones of the forearm. The radius has become larger, longer, and stronger, so that it is now capable of sustaining the whole weight of the animal unassisted by the ulna, which, on the contrary, has degenerated. The ulna has undergone such a degree of degeneration that its central part is reduced to a tapering rod of bone, which fails to reach the distal end of the forearm. Thus the distal or lower end of the ulna has become detached from the rest of the bone, and has fused with the distal end of the radius.

The bones of the leg have undergone a similar modification. The tibia has attained great size and strength, while the fibula has degenerated even more than the ulna. All that is now left of the fibula is a very variable spicule of bone, of no use as affording support to the weight of the body, and a distal end, which has been incorporated with the distal end of the tibia.

As was inevitable, the disappearance of digits has been accompanied by a large number of modifications in the size and arrangement of the muscles of the limbs. Some of these modifications are of comparatively small moment, some are of much physiological importance. One of them can scarcely escape notice in any systematic examination of the limbs of the horse. Down the back of the metacarpus and metatarsus is a strong flattened structure, commonly known as the "suspensory ligament." In function it undoubtedly serves the purpose of a ligament, inasmuch as it passively supports and prevents over-extension of the fetlock-joint. Morphologically, however, it is a modified muscle, as can be readily determined by a comparison of its position and connections with the interosseous muscles of such an animal as the pig or dog. During the process of reduction of digits and alteration in the posture of the limb, the interosseous muscles of the horse underwent change in two directions. One of them became the strong fibrous structure mentioned above. The others dwindled so that at the present time they are represented by two exceedingly rudimentary muscles, one on each side of the "suspensory ligament," which are incapable of serving any useful purpose.

It is manifestly impossible in the small space available in a work of this nature to discuss all the interesting structural peculiarities of the horse; but perhaps sufficient has been said to show that there are anatomical features which merit study, because, while they modify the physiology of the animal, they also afford evidence of the ancestral history of the possessor.

THE SKELETON.

THE SKELETON is a framework of relatively hard texture which serves to support and protect the softer tissues of the body (see Plate III.). It almost entirely consists of a series of bones which are of various shapes and sizes, and which are everywhere continuous with each other (except at the junction of the fore-limb with the trunk). Some parts of the skeleton, however, consist of a softer material, called cartilage. These parts are simply portions of the fœtal skeleton which have not become converted into bone, and which in most cases persist in this condition throughout life. Examples of these are the cartilages of the third phalanx, the costal cartilages, the cartilages of the sternum, etc. Where one bone comes into contact with another a joint is formed. Here the bones are bound together by fibrous bands, called ligaments, and usually various degrees of movements are allowed to take place. In some types of joints the ligament or tissue uniting the bones is placed between and attached to the opposed surfaces of the bones. This tissue may be so small in amount or so thin that the bones are closely bound together, and therefore no movement is permitted between them (synarthrodial joints), as in the immobile joints of the skull. On the other hand, the uniting tissue or ligament may be very thick, so thick as to bend, and thus allow the bones to which it is attached some degree of movement, as in the joints between the bodies of the vertebræ (amphiarthrodial joints). In other types of joints (diarthrodial joints) the ligaments are not placed between the bones, but pass from one bone to the other around the joint, thus enclosing a cavity (see Plate A, Figs. 1 to 7). Here the opposed surfaces of the bones are very smooth, usually lie in contact, and are lubricated by a small amount of yellowish-coloured oil-like fluid, called synovia, which is secreted by a thin membrane (synovial membrane) surrounding the joint beneath the ligaments. This fluid may be seen exuding from a wound which opens into one of these joints. Joints of this type are by far the most numerous, including all the large freely movable joints of the body, and almost all those of the limbs, whether large or small. Occasionally, however, in this type of joint a thick pad of fibrous cartilage is interposed between the bones, but not attached to them, and would seem to serve the part of a cushion in diminishing jar and allowing freer movements to take place, as, for instance, the semilunar cartilages of the femoro-tibial articulation (stifle-joint) (see Plate A, Figs. 8 and 9) and the cartilages in the joints between the mandible and the upper portion of the skull.

For descriptive purposes the skeleton may be divided into two portions, axial and appendicular. The axial portion comprises the skull, the vertebral column, the ribs and sternum. The appendicular portion comprises the skeleton of the limbs.

The Skull or Skeleton of the Head* (see Plate III., Figs. 1 to 5) is fixed to the anterior extremity of the vertebral column by means of two small bosses of bone, called condyles, which fit into two oval-shaped cavities on the anterior aspect of the atlas. Here the antero-posterior or nodding movements of the head take place. The skull is held in position partly by ligaments and partly by muscles. It consists of two chief portions, the cranium or brain-case, an oval-shaped closed cavity occupying its posterior portion, in which the brain is securely packed and protected, and the face, which is much longer, placed in front, and consists of a series of light bones which form the cavities of the orbits, nose, and mouth, and give attachments to the muscles of the face and those of mastication. The orbits are the cavities which accommodate the eyes, and are placed one on either side of the skull at the junction of the cranium and face. In the dried skull they are incomplete below and behind. In the young animal the skull is made up of a number of bones, all of which (except the mandible) are so closely bound together that no movements are permitted between them. Nevertheless, the joints or sutures thus formed serve a very important function, since it is here that the growth of the bones in the young animal takes place, and the skull with its contained cavities is thus allowed to increase in size. When the skull has attained its full size these joints disappear and the bones fuse together, so that the outlines of the individual bones cannot be made out in the skull of the old animal.

The mandible, or lower jaw, carries the lower set of teeth, and

* The skull is here described with its long axis in the antero-posterior direction.

remains movably attached to the remaining portion of the skull throughout life. The skeleton of the tongue is formed by the hyoid bone, which consists of a number of bony pieces joined together by ligaments.

When the skull is split into lateral halves its interior is seen to be hollowed out by two main cavities (see Plate B, Figs. 1 and 2). The posterior and smaller is the cranium, which opens behind by a large orifice, called the foramen magnum, into the neural or vertebral canal of the vertebral column. This cavity is imperfectly divided into three compartments, which are named according to the portions of the brain which they accommodate. The anterior or olfactory compartment is much the smallest, and contains the olfactory lobes of the brain; the middle or cerebral is the largest, and contains the cerebral hemispheres; while the posterior or cerebellar contains the cerebellum and medulla oblongata. The anterior and larger of the two main cavities in the skull is elongated in shape, and called the nose or nasal cavity. It is bounded by the bones of the face, and divided into two lateral compartments, called the nasal chambers, by a medially placed complete partition, the septum nasi, which consists largely of cartilage. Projecting into each chamber and attached to its outer wall are two longitudinally directed, somewhat conical-shaped bones, called turbinated bones. One is placed above the other, and each is formed of a delicate paper-like scroll rolled on itself about one and a half times. At the posterior extremity of the chamber is a complex mass of very delicate bony scrolls, the labyrinth of the ethmoid bone (see Plate III., Figs. 3, 4, and 5). Anteriorly each chamber opens to the exterior through the nostril, and posteriorly it opens into the pharynx through the posterior naris. In addition to the cavities of the cranium and nose, there are other smaller cavities in the skull at the junction of the cranium and face. These are the air-sinuses, which simply contain air. They become larger with age, and increase the size of the skull without materially adding to its weight. They all communicate either directly or indirectly with the nasal chambers.

Vertebral Column or Back-Bone (see Plate III., Fig. 1).—The vertebral column consists of a flexible chain of bones which is placed in the middle line of the body towards its dorsal aspect, and extends from the skull to the tip of the tail. The individual bones which compose it are called vertebræ. For descriptive purposes the column is divided into a number of regions, the ordinary names for which are familiar to all who are acquainted with the horse; these are the neck, back, loins, croup, and tail. Anatomically, however, more technical terms are employed; thus, the neck is called the cervical region; the back, the thoracic region; the loins, the lumbar region; the croup, the sacral region; and the tail, the coccygeal or caudal region. Each region contains a definite number of vertebræ, which is usually indicated in formula fashion—*i.e.*, with the initial letter of the name of the region above and to the left of the number; thus, the vertebral formula of the horse is C_7, T_{18}, L_6, S_5, C_{18-20}.

The vertebræ of the different regions, on cursory examination, appear to differ very much from one another, but when examined more closely these differences are found to be due to points of detail, since all the vertebræ (except the atlas) are formed on the same plan, no matter to what region they belong (see Plate C, Figs. 1 to 5); thus, each has a thick rod of bone below, called the body or centrum, and immediately above this is a large circular opening, called the vertebral foramen. The part of the bone which forms the roof and walls of this opening is called the arch of the vertebra. Projecting outwards from either side of the body is the transverse process. Extending upwards from the middle of the arch is the spinous process, and projecting from both anterior and posterior edges of the arch is a pair of processes called the articular processes. On the lower aspect of the centrum, in the middle line, there is generally a ridge. The apparent differences which exist between the vertebræ of the different regions are due chiefly to differences in size or development of these several processes, and not to any deviation from the common plan on which the vertebræ are formed; thus, the spinous processes are very large in the thoracic vertebræ and very small in the cervical; and the transverse processes are very large in the lumbar vertebræ and very small in the thoracic (see Plate C, Figs. 2 to 5). When all the vertebræ are in position the series of vertebral foramina form, along with the ligaments between the vertebræ, a canal which traverses the length of the vertebral column and accommodates the spinal cord. It is called the vertebral or neural canal. The bodies of the vertebræ are strongly united by disc-like pieces of tissue less than one-half inch thick, called intervertebral fibro-cartilages. It is these discs which bend, and thus allow the movements to take place between the bodies during the movements of the vertebral column. In the sacral region the discs are absent, five of the vertebræ being here ossified together to form a single bone, called the sacrum. The articular processes of adjacent vertebræ are applied to one another in an oblique fashion, so that the vertebræ appear to be dove-tailed into one another as if to combine strength with the greatest possible amount of movement. The vertebræ in each region are named numerically from before backwards, but the first and second cervical also receive special designations; thus, the first cervical vertebra is also called the atlas, and the second the axis or epistropheus.

In its formation the *Atlas* departs from the common plan of the other vertebræ, being specially modified for articulation with the skull. It simply consists of a bony ring surrounding a very large vertebral foramen to either side, of which an oblique plate called the wing is attached. *The Axis or Epistropheus* (see Plate C, Fig. 1) is specially modified at its anterior extremity for articulation with the atlas, carrying here a process

on the anterior extremity of the body, around which the atlas rotates as if on a pivot during the side-to-side movements of the head—*i.e.*, the movements which take place when the animal shakes his head.

The Chest or Thorax.

The Chest or Thorax (see Plate III., Fig. 1) is laterally flattened and conical in shape, bounded above by the thoracic vertebræ, on either side by the ribs, and below by the sternum. When the spaces between these bones are filled in by soft tissues the chest is a closed cavity which contains and protects vital organs such as the heart, the lungs, and the large bloodvessels.

The Ribs are curved, highly elastic rods of bone placed in series on either side of the chest. They are named numerically from before backwards, and number eighteen pairs, one for each thoracic vertebra. Above they are articulated to the thoracic vertebræ, and below they are prolonged by rods of cartilage, the costal cartilages, the first eight pairs of which articulate with the sternum at their distal extremities, while the last ten do not come into contact with the sternum, but are attached to one another in series by fibrous tissue. The first eight pairs of ribs are called sternal ribs, since their costal cartilages articulate with the sternum, while the last ten pairs are called asternal ribs, since their costal cartilages do not reach this bone below. The ribs have all a slight backward inclination, so that when drawn forward by the muscles of inspiration their middle portions are at the same time carried outwards, and the transverse diameter of the chest is thus increased.

The Sternum or Breast-Bone is placed in the floor of the chest, and is suspended to the thoracic vertebræ by means of the sternal ribs. It is somewhat canoe-shaped, and consists of seven segments of bone united by cartilage, as well as of a piece of cartilage at either extremity. Its lower border is thin and sharp, so that the horse cannot lie comfortably on the lower aspect of his chest.

The Fore-Limb or Thoracic Limb.

The Fore-Limb for descriptive purposes is divided into a number of segments corresponding to those in the upper extremity of the human subject. Thus, there is the shoulder, the skeleton of which is formed by the scapula; the arm or brachium, formed by the humerus; the forearm or antibrachium, formed by the radius and ulna; the manus or forefoot, which corresponds to the human hand and includes the carpal, metacarpal, and digital regions.

The Scapula (see Plate C, Fig. 6) is a flat, triangular-shaped bone which lies on the antero-lateral aspect of the chest wall, to which it is attached by muscles. It carries a longitudinal ridge, the spine, on its outer surface for the attachments of muscles, and on its lower angle is an oval-shaped, shallow cavity which meets the head of the humerus in the shoulder-joint. There is no clavicle, so that there is no direct connecting-link between the bones of the fore-limb and those of the trunk; the two structures being connected by muscles only. Owing to the resilient nature of this union, the concussion produced by the foot striking the ground is to a large extent neutralized. During the movements of the fore-limb the scapula rocks on the chest wall, and in this way the absence of a joint here is compensated.

The Humerus (see Plate C, Fig. 12) is a long, almost cylindrical bone which extends obliquely downward and backward from the shoulder-joint above to the elbow-joint below. Projecting outward from its upper third is a process, called the deltoid tuberosity, which gives attachment to the deltoid muscle. Its lower extremity is somewhat pulley-like, and meets the radius and ulna in the elbow-joint. On the posterior aspect of this extremity are two thick plate-like processes, the epicondyles, which give attachment to some of the muscles of the forearm.

The Radius (see Plate C, Figs. 8 and 9) is much the larger of the two bones of the forearm. It is a long, somewhat semicylindrical bone extending nearly vertically between the elbow-joint above and the knee or carpal joint below. At either side of its lower extremity it carries a prominence, distinctly seen in the living animal above the carpal joint.

The Ulna (see Plate C, Figs. 8 and 9) is rudimentary in the horse. Its lower portion is detached from the rest of the bone and is fused with the distal end of the radius. The ulna is very firmly bound to, and even ossified with, the upper half of the posterior aspect of the radius; so firm is this bond of union that no movements are permitted between these two bones, and the movements of supination* and pronation,* so well seen in the human subject, are thus lost. Its upper extremity is the most massive part of the bone, called the olecranon, and forms the skeleton of the point of the elbow.

The Carpal Region (see Plate A, Figs. 2, 3, and 6; also Plate C, Fig. 10), more commonly known as the knee-joint, corresponds to the human wrist, and contains seven or sometimes eight small carpal bones, which are disposed in two transverse rows one above the other. The proximal (upper) row articulates with the lower extremity of the radius, and the distal (lower) row with the upper extremities of the metacarpal bones. The bones in each row are named in the following order from the inner (medial) border of the limb outwards:

Proximal Row: Radial carpal (scaphoid); intermediate carpal (semilunar); ulnar carpal (cuneiform); accessory carpal (pisiform).

Distal Row: First carpal (trapezium), not always present; second carpal (trapezoid); third carpal (os magnum); fourth carpal (unciform).

* Supination is that movement seen in the fore-limb of the dog when the animal turns the sole of the foot inwards as if holding something between the paws. Pronation is the movement which brings the foot back again into its normal standing position.

These small bones move on one another during movements of the joint, and serve to diminish concussion by distributing and equalizing pressure, thus preserving one side of the limb from more undue jar than the other.

The metacarpal region contains only three bones (see Plate C, Fig. 13), those corresponding to the first and fifth (inner and outer) in the manus of the dog being entirely suppressed. Only one is fully developed and carries a digit; this corresponds to the third in the dog, and is called the large metacarpal or cannon bone. It extends vertically between the knee-joint above and the fetlock-joint below. The other two (second and fourth) are very rudimentary, commonly called splint bones, and are placed one at either side of the posterior aspect of the upper half of the third metacarpal (cannon bone), to which they are firmly attached. The lower extremity of each very often carries a small nodule, called the "button of the splint," which can be felt beneath the skin. Behind the lower extremity of the third metacarpal are two small sesamoid bones, over the posterior aspect of which the tendon of the deep digital flexor muscle plays.

The digital region contains only one digit (see Plate C, Figs. 7 and 3B). This corresponds to the third digit of the dog or the middle finger of the human hand. It is directed obliquely downward and forward from the fetlock-joint above to the sole of the hoof below, and consists of three main bones, called phalanges, as well as a small shuttle-shaped bone called the navicular or sesamoid of the third phalanx (see Plate A, Fig. 18) placed behind the coffin-joint. These phalanges are named numerically from above to below, but they also receive special designations. Thus, the first is also called the os suffraginis; the second the os coronæ; and the third the os pedis or coffin bone. The joint between the first and second is called the pastern or proximal interphalangeal joint, and that between the second and third the coffin or distal interphalangeal joint (see Plate A, Fig. 18). The third phalanx is entirely covered by the hoof, which it resembles in shape. To it on either side is attached a small vertically placed plate of cartilage, the cartilage of the third phalanx (lateral cartilage) (see Plate A, Fig. 12), which projects upwards for a short distance above the level of the posterior part of the wall of the hoof beneath the skin. It can be here manipulated in the living animal and made to bend beneath the pressure of the finger, being quite flexible, but in that abnormal condition called "side-bone" it is converted into bone, and is hard and rigid.

The hoof (see Plate A, Fig. 10) forms a thick horny covering for the terminal portion of the digit. It is really a thickened, highly modified portion of the epidermis which is not sensitive. When the foot is in its normal position on the ground, that portion of the hoof which is visible is called the wall, and that portion which looks towards the ground the sole. Projecting below the level of the posterior part of the sole is a **V**-shaped pad of soft horn, called the frog. Posteriorly—*i.e.*, at the heel—the wall is reflected forwards to form a ridge at either side of the frog, called the bar. Between the hoof and the bony, cartilaginous and fibrous skeleton of the foot there is a very vascular and sensitive layer of tissue known as the matrix or sensitive foot. This connects the hoof with the skeleton, and is beset with papillæ and ridges, which fit into small holes in or between ridges of the hoof. On the surface of the matrix are soft epidermic cells from which the hoof is developed (see Plate A, Figs. 11 to 13). That portion of the matrix on the anterior surface of the third phalanx is in the form of numerous very fine vertically placed leaves, called laminæ. Inflammation of these gives rise to the condition known as "laminitis." Above these laminæ, and lying just beneath the upper border of the wall of the hoof, is a thick band of sensitive tissue, the coronary matrix or cushion, with which the growth of the wall of the hoof is connected. The sole of the hoof is connected with the sensitive tissue on the lower surface of the third phalanx. Above the frog is a thick elastic pad of sensitive tissue, called the digital torus or plantar cushion, which plays an important rôle in the expansion and absorption of shock which takes place in the posterior part of the foot when the frog comes into contact with the ground.

Hind-Limb or Pelvic Limb (see Plate III., Fig. 1).

For descriptive purposes the hind-limb is divided into segments corresponding to those in the lower extremity of the human subject. Thus, there is the hip or haunch, the skeleton of which is formed by the hip or innominate bone; the thigh, the skeleton of which is formed by the femur and patella; the leg, the skeleton of which is formed by the tibia and fibula; the pes or hind-foot, which corresponds to the human foot, and consists of the tarsal, metatarsal, and digital regions. The hind-limb, unlike the fore, is directly joined to the trunk by means of a joint between the ilial portion of the hip-bone and the sacrum. These two latter structures are very strongly bound together by powerful ligaments.

The Innominate Bone or Os Coxæ (see Plate III., Figs. 6 and 7) is very irregular in shape, forms the skeleton of the hip or haunch, and extends inwards in the floor of the pelvis to unite with its fellow of the opposite side along a median line called the pelvic symphysis. Its ilial portion is articulated to the sacrum above. In the fœtus the hip-bone consists of three parts—viz., the ilium, ischium, and os pubis, which afterwards become fused together around a deep cavity, the acetabulum, which accommodates the head of the femur in the hip-joint. The ilium is placed in front, and carries two very prominent angles: one is the coxal tuber or angle of the haunch, which projects outwards to form a distinct prominence in the living animal a short distance above and in front of the level of the hip-joint; the other is the sacral tuber or angle of the croup, which projects inwards and

upwards above the level of the sacrum. The ischium is placed behind on the floor of the pelvis. Its postero-external angle is prominent, forming the sciatic tuber. The posterior edges of the two ischia form a deep Λ-shaped notch, the sciatic arch. The os pubis is small, placed in front in the floor of the pelvis. Immediately behind it is a large opening, the obturator foramen.

The Pelvis is that cavity the skeleton of which is formed by the innominate bones below and at the sides, and by the sacrum above. It is continuous with the abdominal cavity in front, and accommodates the rectum and portions of the genital organs.

The Femur (see Plate C, Fig. 15) is the most massive bone in the body. It is elongated, nearly cylindrical in shape, and extends obliquely downward and forward from the hip-joint above to the stifle-joint below. Its upper extremity carries an almost spherical-shaped process, called the head, which fits in the acetabulum of the innominate bone in the hip-joint. To the outer side of the head is a very large upward projecting process, called the great trochanter, and a little above the middle of the bone is a smaller outward projecting process, the third trochanter. At the same level as the latter, but projecting from the inner side of the bone, is the lesser trochanter. The lower extremity of this bone carries in front a pulley-like area for articulation with the patella, and behind two oval-shaped condyles for articulation with the tibia in the stifle-joint; but here the two semilunar cartilages are interposed between the bones, one opposite each condyle. This joint corresponds to the human knee-joint (see Plate A, Figs. 8 and 9).

The Patella (see Plate III., Fig. 1) corresponds to the human knee-cap and is nearly prismatic in shape. It is attached to the upper extremity of the tibia by three bands and gives insertion to the extensor muscles* of the stifle-joint (quadriceps femoris muscles). It floats on the pulley-like area on the anterior aspect of the lower extremity of the femur.

The Tibia (see Plate C, Fig. 14) is much the larger of the two bones of the leg. It is elongated, three-sided in shape, and extends obliquely downward and slightly backward from the femur above to the tarsus below. Its inner surface lies directly beneath the skin. On either side of its lower extremity is a projection, called a malleolus, which forms a distinct prominence above the hock. The lateral malleolus is morphologically the distal end of the fibula, which has separated from the rest of this bone and fused with the tibia.

The Fibula (see Plate C, Fig. 14) is very rudimentary in the horse. It is not unlike a splint bone in appearance, and is attached to the upper half of the outer edge of the tibia. Between these two bones is a small interosseous space, through which bloodvessels pass.

The Tarsal Region or Hock (see Plate C, Fig. 11) corresponds to the human ankle, and consists of six small bones, called tarsal bones, which are disposed in two transverse rows one above the other, with one of the bones interposed between the two rows. The upper row consists of only two bones—viz., the tibial tarsal (talus or astragalus) and the fibular tarsal (os calcis or calcaneus). The former is pulley-like above and articulates with the tibia. The latter carries a strong upward projecting process, the tuber of the calcaneous, which forms the skeleton of the "point of the hock," corresponding to the point of the human heel. The bones of the lower row are named in the following order from the inner side of the limb outward: The first and second tarsal (small cuneiform)—these two bones are nearly always fused together; the third tarsal (large cuneiform); the fourth tarsal (cuboid). The bone which intervenes between the rows is called the central tarsal (scaphoid). That condition known as spavin involves most of the small bones which lie towards the inner aspect of the hock.

The metatarsal and digital regions (see Plate C, Figs. 16 and 7) correspond to and are almost identical with the metacarpal and digital regions in the fore-limb. Thus, there are three metatarsal bones, one large bone and two small ones (splint bones). The bones of the digit and the hoof so closely resemble those of the fore-limb that they can only be distinguished from them with difficulty.

MUSCULAR SYSTEM

(See Plate I.; also Plate II., Fig. 1).

The organs which bring about the different movements of the body are known as muscles, strong fleshy bands which vary greatly in size and shape, and are endowed with the power of perfect elasticity—that is, of becoming longer or shorter or assuming their natural shape as required. By shortening the muscles can move bones or other structures to which they are attached, and in this way the different movements of the body, as those of locomotion, etc., are brought about. The actions of some muscles are not under the voluntary control of the animal, as those in the walls of the intestines, bladder, etc., and are therefore called involuntary muscles; while others can be contracted and relaxed according as the will directs, and are therefore called voluntary muscles. The latter are by far the larger and more numerous, and are nearly all attached to some part of the skeleton. (The muscle of the heart belongs to a special type.) The largest muscles are found towards the surface of the body beneath the skin, and almost completely cover and thus protect the deeper parts. The shape and form of these to a large extent determine the conformation of the body. Between them and separating them from the skin is a variable amount of loose fibrous material, called fascia. In most voluntary muscles a reddish fleshy (belly) and a white tendinous portion can be distinguished; the former is the

* An extensor muscle of a joint is one which increases the size of the angle formed by the meeting of the two bones of the joint—*i.e.*, tends to bring these bones into the same straight line. A flexor muscle is one which brings about the opposite movement.

portion which really possesses the contractile power; the latter plays only a mechanical part during contraction of the muscle, and it varies in shape, being in some cases round and cord-like, as in the muscles of the limbs, while in others it is flat and sheet-like, as in the muscles of the back and abdomen. The attachments of a voluntary muscle are usually distinguished as origin and insertion. The origin is that attachment which usually remains fixed or stationary, while the insertion is that which usually moves during contraction of the muscle. The stimulus for contraction is brought to a muscle through its nerve-supply, so that if the nerves supplying a muscle be cut or destroyed it loses its normal power of contraction—*i.e.*, it is paralyzed. Most of the long tendons of the muscles of the limbs play through synovial sheaths at certain parts, especially in the neighbourhood of joints. These sheaths are lined by synovial membrane and lubricated with a small amount of synovia, identical with that found in diarthrodial joints. The largest of these are—one behind the knee-joint (carpal sheath), one behind the hock (tarsal sheath), and one behind the fetlock-joint in both hind and fore limbs (sesamoidean sheath) (see Plate A, Fig. 18).

Muscles of the Head and Neck.

The muscles of the face are thin, flat, and serve to move the lips, cheeks, nostrils, and eyelids. Thus, passing from the bones of the face to the lips and nostrils are the levator of the nose and upper lip (M. levator naso-labialis); the proper levator of the upper lip; the lateral dilator of the nostril; the zygomatic; and the depressor of the lower lip. Forming the main thickness of the lips is a muscle, the orbicularis oris, whose fibres run parallel to the free border of the lip. A somewhat similarly disposed muscle is present in the eyelids. The muscles which are attached to the nostril serve to dilate it at each inspiration. In the substance of the inner wing of the nostril is a comma-shaped piece of cartilage (see Plate B, Fig. 4). The main thickness of the cheek is formed by the buccinator muscle. The movements of the lower jaw or mandible are brought about by the muscles of mastication, which are attached to this bone on the one hand and to the upper portion of the skull on the other. Those which raise the mandible—*i.e.*, close the mouth—are the masseters, the temporals, and internal pterygoids. Those which open the mouth are the jugulo-mandibular and digastricus; while those producing the side-to-side movements of the jaw are the external pterygoids. A set of small muscles (auricular muscles) (see Plate B, Fig. 3) are attached to the pinna (commonly known as the ear), and serve to direct its opening towards the source of the sound.

The head and neck are supported chiefly by large muscles which lie above the level of the cervical vertebræ, but these are assisted by a remarkably large, highly elastic structure, the ligamentum nuchæ, which is placed in the median plane between the muscles of each side of the neck, and extends from the longest spinous processes of the thoracic vertebræ at the withers to the posterior extremity of the skull and spinous processes of the cervical vertebræ. The largest of the muscles of the neck —viz., the splenius and semispinalis capitis (complexus)—are attached to practically the same bones as the ligament, and for the greater part lie in contact with it. The cervical portion of the ventral serrate muscle extends from the upper portion of the scapula to the transverse processes of the last four cervical vertebræ. Running along the lower portion of the side of the neck is a wide, shallow groove, the jugular furrow, in which is the jugular vein, lying here nearly directly beneath the skin. Still deeper than and slightly above the level of this vein in the bottom of the groove is the common carotid artery. Bounding this groove above is the brachio-cephalic (mastoido-humeralis) muscle, which is attached above to the skull and first three or four cervical vertebræ and extends down the side of the neck, passing over the shoulder-joint, to be inserted into the outer aspect of the humerus. Below the groove is the sterno-cephalic (sterno-maxillaris) muscle, which is attached below to the anterior extremity of the sternum, and extends up the lower aspect of the neck to be inserted into the mandible near its angle. On the lower aspect of the neck, in the middle line, is the sterno-thyroid and sterno-hyoid muscles, which extend from the sternum to the hyoid bone and larynx.

Muscles of the Fore-Limb.

As already described, the trunk is suspended between the fore-limbs by means of muscles only, no joints or ligaments participating in this union. Most of these muscles pass from the trunk to the scapula, but a few are inserted into the humerus. The trapezius, the rhomboid, and the cervical and thoracic portions of the ventral serrate (serratus magnus) muscles, are those attaching the scapula to the trunk, whilst three pectoral muscles and the latissimus dorsi pass from the sternum and back respectively to be inserted into the humerus; as well as these, the already mentioned brachio-cephalic muscle passes down the side of the neck to the humerus. Many muscles pass from the scapula to the humerus; the chief of these are on the outer aspect of the scapula—viz., the supra- and infra-spinatus and deltoid. Others passing between these two bones are the subscapularis, the teres major and minor. In front of the humerus is the biceps brachii muscle, which arises from the coracoid process on the lower angle of the scapula, and is inserted below into the upper extremity of the radius close to the insertion of the brachialis muscle, which comes from the outer surface of the humerus. Filling in that large triangular-shaped space between the posterior border of the scapula and the humerus is the large triceps muscle of the arm, which has three heads of origin, and is inserted into the olecranon of the ulna. The biceps brachii and brachialis are the chief flexors of the elbow-joint; while the triceps is the chief extensor.

There are three chief flexor muscles of the knee-joint or carpus placed in the back of the forearm. They arise from the epicondyles of the humerus, two from the flexor (medial) and one from the extensor (lateral), and are inserted below into the accessory carpal and splint bones. The outer is called the extensor carpi ulnaris* (flexor carpi externus); the middle is the ulnar flexor of the carpus (flexor carpi medius); and the inner is the radial flexor of the carpus (flexor carpi internus). Beneath these muscles the superficial and deep flexors of the digit arise from the flexor (medial) epicondyle of the humerus, but the deep flexor also arises from the radius and ulna. The tendons of these flexors of the digit are long, and descend through the carpal sheath, then downward behind the metacarpal bones, and thence over the sesamoids at the back of the fetlock-joint, to be inserted into the volar aspect of the digit: the superficial into the second and the deep into the third phalanx. The tendon of the deep flexor lies immediately in front of that of the superficial, and passes through the sesamoidean sheath at the back of the fetlock. Passing downward from the back of the knee-joint is a broad band, the subcarpal or check ligament, which is inserted into the deep flexor tendon about the middle of the metacarpus. Lying between the splint bones immediately in front of the deep flexor tendon is a broad ligamentous band, the interosseous muscle (superior sesamoidean or suspensory ligament), which is attached above to the lower row of carpal bones and below by two bands to the sesamoids, while some of its fibres are continued downward and forward round the sides of the digit to join the tendon of the common digital extensor. The tendons and ligaments behind the metacarpus support the fetlock and maintain it in its normal position (see Plate A, Figs. 14 to 17). As a result of excessive strain they are often sprained, as a consequence of which they become inflamed, swollen, and thickened. Should they be accidentally ruptured, the fetlock loses its support, and therefore sinks almost to the ground.

* In man and in the dog this muscle is an extensor of the manus.

On the anterior and lateral aspects of the forearm are four extensor muscles, two of which—viz., the radial extensor of the carpus and the abductor pollicis muscle—serve only to extend the knee-joint; another—viz., the lateral extensor of the digit—serves to extend the knee and fetlock joints; while the fourth—viz., the common extensor of the digit—serves to extend the knee, fetlock, pastern, and coffin joints. The radial extensor of the carpus is inserted into the upper extremity of the large (third) metacarpal bone; the abductor pollicis into the inner splint (second metacarpal) bone; the lateral extensor of the digit into the first phalanx; and the common extensor of the digit (extensor pedis) into the third phalanx. All these extensors, as well as the extensors of the elbow-joint (triceps), receive their nerve-supply from the radial or musculo-spiral nerve, so that if this nerve is injured there is inability on the part of the animal to extend the elbow or any of the joints below it. The animal therefore stands with these joints flexed, the fetlock knuckled over, the tip of the toe on the ground, the knee bent, and the elbow apparently dropped. On account of this appearance of the elbow the condition is commonly known as "dropped elbow."

Muscles of the Trunk.

The superficial muscles in the neighbourhood of the back are very thin, flat, and for the greater part tendinous. These are the serratus anticus and posticus (dorsal serratus), and the latissimus dorsi. The last becomes thick and fleshy on the side of the chest behind the shoulder, and is inserted into the inner (lesser) tubercle of the humerus by a thin tendon. The chief deep muscles in the back region are the transversalis costarum (M. iliocostalis) and the longissimus dorsi. The latter is the largest muscle in the body, and fills in that groove or space between the spinous processes of the vertebræ and the upper parts of the ribs. Filling in the spaces between the ribs are thin muscles, which therefore complete the wall of the chest. These are composed chiefly of the external and internal intercostal muscles, and they effect the separating and drawing together of the ribs during the movements of respiration. The remaining muscles of the chest have either been mentioned with those of the back and fore-limb or will be dealt with in connection with the muscles of the abdomen. Here, however, is the most convenient position to describe the diaphragm (see Plate II., Fig. 3). This forms a fibro-muscular partition between the cavity of the chest and that of the abdomen, and acts as an important muscle of inspiration. It is attached at its periphery to the asternal costal cartilages on either side, and to the lumbar vertebræ above and sternum below. It is very convex or dome-like towards the chest. It is constantly in action during life, the central portion being drawn backwards in order to increase the capacity of the chest at each inspiration.

The abdominal walls, unlike those of the chest, are not supported by ribs or bones, so that the cavity of the abdomen is chiefly dependent for its shape on a series of layers of flat muscles which stretch between the chest walls in front, the lumbar vertebræ above, and the pelvis behind. These layers from without inwards are the cutaneous muscle (panniculus carnosus), the abdominal tunic, the external oblique abdominal muscle, the internal oblique abdominal muscle, the rectus abdominis muscle (only present on the floor), and the transversalis abdominis muscle. The panniculus carnosus is a muscular sheet which extends over the greater part of the side of the chest and abdomen, and is closely attached to the overlying skin, which it serves to twitch, and thus assist in removing offending objects such as flies. The abdominal tunic, unlike the other layers of the abdominal wall, does not consist of muscle, but of a thin sheet of elastic tissue, whose function is apparently

to assist these abdominal muscles in supporting the voluminous abdominal contents. The fibres in any one of these muscles are always directed at right angles to those in the subjacent muscle, thus effecting the maximum amount of strength. Besides the passive function of furnishing the walls of the abdominal cavity, these muscles play an important part in the movements of respiration, being almost continually on the move during life.

Immediately in front of the pelvis the abdominal floor is perforated at either side of the middle line by a slit-like oblique passage, called the inguinal canal, through which the testicle descends from the abdominal cavity (where the testicle is developed) to the scrotum in the young colt, and in which are accommodated certain vessels and nerves, also the spermatic cord in the adult stallion. Its posterior wall is formed by a thin tendon, called the inguinal or Poupart's ligament, which is normally in contact with its anterior wall, so that no actual passage exists except where the before-mentioned structures pass through the canal.

Muscles of the Hind Limb.

Lying on the dorsal aspect of the ilium and forming the highest limit of the hind-quarter is a very large muscular mass, formed chiefly by the gluteus medius muscle, which is inserted into the great trochanter of the femur. It serves to assist in extending the hip-joint, and is also an important muscle in rearing; to some extent it is assisted by the deep gluteus muscle, which lies beneath it. Several small muscles and some large ones pass from within the pelvis and abdomen, to be inserted into the upper part of the femur. These perform various movements, chiefly flexion of the hip-joint and rotation of the femur. The largest and most important is the psoas major, which arises from the lower aspects of the lumbar and last two thoracic vertebræ, and passes back to emerge from the abdomen behind Poupart's ligament and become inserted into the lesser or internal trochanter of the femur.

In front of the femur is a large group of extensor muscles, called the quadriceps femoris muscles. These consist of four parts, one of which—viz., the rectus femoris—arises from the ilium, while the other three—viz., the vastus internus (medialis), the vastus externus (lateralis), and the vastus intermedius—arise from the femur; but all are inserted into the patella, and thus, indirectly, through the three patellar ligaments into the tibia. They are all important extensors of the stifle-joint. The adductor* muscles of the hip-joint (see Plate II., Fig. 1) consist of a group forming the bulk of the inner portion of the thigh. Most of these arise from the lower aspect of the pelvic floor, and are inserted into the inner aspect of the femur. The chief muscles are the adductor magnus and parvus, the sartorius, and the semimembranosus. Behind the femur and forming the posterior part of the bulk of the thigh are two large muscles, the biceps femoris and the semitendinosus, which arise chiefly from the ischium and spinous processes of the sacrum, and pass down behind the femur to the upper portion of the tibia. The first winds round the outer side of the tibia and the second round its inner side, but both act as flexors of the stifle-joint. On the outer aspect of the thigh two other comparatively small muscles can be seen—viz., the tensor fasciæ latæ and superficial gluteus. The former is placed in front, and extends from the angle of the haunch to the fascia on the outer side of the thigh; the latter is V-shaped, with its apex inserted into the third trochanter of the femur. Both these assist in flexing the hip-joint.

In front of the tibia is a group of muscles (see Plate I., Fig. 5). The most superficial is the largest, and is called the long extensor of the digit, or extensor pedis; the deepest is called the tibialis anterior (deep portion of the flexor metatarsi), and between these is a tendinous band, called the peronæus tertius (superficial portion of flexor metatarsi), which acts as a mechanical flexor of the hock when the stifle-joint is flexed. The long extensor of the digit arises from the lower extremity of the femur, and its tendon passes down beneath three transverse fibrous bands in front of the hock to be finally inserted into the third phalanx. It extends the joints of the digit and the fetlock, and also assists in flexing of the hock. The other two of these muscles are flexors of the hock, and are both inserted into the lower row of tarsal bones and upper extremity of the large metatarsal bone; the deeper—viz., the tibialis anterior—arises from the tibia, while the peronæus tertius arises from the femur in company with the long extensor of the digit. Running down the outer aspect of the leg and hock is the peronæus muscle, which arises from the fibula and is inserted into the tendon of the long extensor of the digit, which it assists in its action.

Lying at the back of the tibia (see Plate I., Fig. 6) are the gastrocnemius, the plantaris (superficial flexor of the digit), and the deep flexor of the digit. The first two arise from the lower portion of the femur, and their tendons above the hock form a half-twist with one another, that of the gastrocnemius being at first superficial to, and later turns beneath, that of the plantaris, to become inserted into the tuber calcis. At this twist they form a single rope-like band, called the "tendon of Achilles." The plantaris or superficial flexor tendon is then continued down over the top of the tuber of the calcaneus, and thence downward in the metatarsal region immediately behind that of the deep flexor of the digit, to be finally inserted into the second phalanx. The deep flexor of the digit is the most deeply placed, and arises from the tibia and fibula by three heads, which usually receive special names. Its tendon descends through the tarsal sheath, then downwards in the metatarsal region, passing over the sesamoid bones and through the sesamoidean sheath, to be

* An adductor muscle is one whose contraction tends to draw the distal extremity of the distal bone of the joint inward towards the median plane of the body. An abductor muscle serves the opposite function.

ultimately inserted into the third phalanx. All these muscles behind the tibia serve to extend the hock, but the superficial and deep flexors of the digit also flex the fetlock and joints of the digit, as in the fore-limb. The gastrocnemius is assisted in its action by a very small muscle, the soleus, which comes from the fibula to join its tendon. The arrangement of the ligaments and tendons behind the metatarsus and digit is identical with that in the corresponding regions in the fore-limb; thus, the check and suspensory ligaments are present behind the metatarsal bones, immediately in front of the deep flexor tendon, while the latter tendon is immediately in front of that of the superficial flexor.

CIRCULATORY SYSTEM

(See Plate IV.).

Running through the tissues of the body in all directions is a series of closed tubes, known as arteries, capillaries, and veins, in which a perpetual circulation of blood is kept up by means of the heart, which acts the part of a pump in forcing the blood through these vessels. The blood thus in circulation serves to carry nutritive material from the alimentary canal and oxygen from the lungs to all the tissues throughout the body; also, and not less important, it serves to convey waste products from the tissues to the kidneys to be excreted in the form of urine, and to the lungs to be expired in the form of carbonic acid gas. The oxygen taken up by the blood in the lungs is conveyed to the tissues, in which it has the power of burning up all useless, undesirable accumulations, so that the purification of the tissues and the production of the necessary body heat are thus carried out at the same time. The used-up oxygen is converted in the tissues into carbonic acid (carbon dioxide), which is carried by the blood to the lungs to be expired; while other waste products and impurities which are created by these burning-up processes in the tissues are separated from the blood as it passes through the kidneys, and thence carried to the exterior as urine. A small amount of impurity and water, however, are also got rid of through the skin in the form of sweat.

Blood is a reddish-coloured fluid, and consists of a clear liquid, called plasma, in which are suspended myriads of very minute bodies, the blood-corpuscles. It is chiefly in the plasma that the nutritive material and waste products of the tissues are contained. The corpuscles are of two kinds—viz., red or erythrocytes, and white or leucocytes. The former are by far the more numerous, and contain a yellow material, called hæmoglobin, which is endowed with the power of taking up oxygen in the lungs and giving it off to the tissues. The leucocytes serve as cleaners or scavengers for the body, many of them possessing the power of taking foreign particles, such as germs, into their own bodies and destroying them.

Arteries have thick, highly elastic walls, and serve to carry the blood away from the heart to the tissues; while veins have thin walls, and carry the blood from the tissues back to the heart. Most veins, especially those of the limbs, possess valves, which serve to prevent the contained blood from being driven backward away from the heart. Connecting the arteries and veins is a system of very minute vessels, called capillaries, which form a network in the tissues. Through the capillary walls, which are very thin, the oxygen and nutritive material pass from the blood to the tissues, and the carbonic acid and waste products pass from the tissues into the blood; in the lungs, however, the oxygen and carbonic acid pass through their walls in the reverse direction—*i.e.*, the oxygen is taken into the blood and the carbonic acid is given off.

The Heart (see Plate IV., Fig. 1) is a conical-shaped hollow muscular organ whose cavity is divided into four chambers, two on either side, one above the other. The upper on each side is called the auricle or atrium, and the lower the ventricle, so that there are two auricles, a right and left, and two ventricles, a right and left. The organ during life is perpetually expanding and contracting. During expansion the blood flows into the auricles from the veins, and thence down into the ventricles, from which it is driven out into the arteries at the next contraction. The heart is enclosed in a fibrous sac, called the pericardium, and lies in the lower portion of the thorax (with its apex directed downwards), opposite the ribs from the third to the sixth and in contact with both chest walls. Between either auricle and the corresponding ventricle is a valve, the auriculo-ventricular valve, which consists of comparatively thin triangular-shaped flaps or cusps, two for the left valve and three for the right. At the beginning of the contraction of the ventricle the valve closes, and thus prevents regurgitation of blood from the ventricle up into the auricle. These valves, right and left, close simultaneously, and it is chiefly this act which produces the first sound ("lūb") of the heart. At the opening from either ventricle into the artery leading from it is a valve, the semilunar valve, which consists of three crescentic cusps. At the beginning of the expansion of the ventricle this valve closes, and thus prevents regurgitation of blood from the artery to the ventricle. These valves, right and left, close simultaneously, and it is this act which produces the second sound ("dub") of the heart. The first five ribs are covered by the fore-limb, so that in auscultation of the heart it is necessary to have the fore-limb held forwards as far as possible by an assistant, in order to expose that part of the chest wall opposite this organ.

The arteries are always full, so that when more blood is pumped into these already full vessels by the ventricular contraction their walls, owing to their elastic nature, expand. It is this expansion which can be felt at each contraction of the heart in some of the larger arteries beneath the skin, and which constitutes what is called the "pulse."*

* The normal frequency of the pulse is about 36 to 40 per minute.

The blood circulates in two circuits—viz., the pulmonary or short circuit and the systemic or long circuit. In the pulmonary circuit the blood in the right auricle passes into the right ventricle, from which it is pumped into the pulmonary artery and thence to the lungs, in which it is collected by the pulmonary veins and returned by them to the left auricle; here the short circuit ends and becomes continuous with the long or systemic circuit. In this the blood in the left auricle passes into the left ventricle, from which it is pumped into the aorta, and thence to all the tissues of the body (save the lungs), in which it is collected by the systemic veins and returned by them to the right auricle; here the long circuit ends and becomes continuous with the short circuit. As already described, the pulmonary artery carries impure blood from the right ventricle of the heart to the lungs to be aerated. This vessel bifurcates and a branch enters each lung, in which it divides again and again until capillaries are formed, these being arranged in a network around the alveoli or small air-spaces in the lung tissue. Here the blood comes into intimate relationship with the alveolar air, to which it gives up carbonic acid and a small amount of water, and from which it absorbs its oxygen. This interchange of gases between the blood and the air in the small lung-spaces takes place through the thin capillary walls. The blood thus aerated is collected by small veins, which unite again and again to form the pulmonary veins, which, as already described, pour it into the left auricle. The aerated blood is of a bright red colour, whereas the non-aerated blood—*i.e.*, that going to the lungs—is dark or nearly black in colour.

The Aorta (see Plate IV., Fig. 1) carries the blood from the left ventricle of the heart, and distributes it to all the tissues of the body (save the lungs). To these tissues the blood gives up its oxygen, and from them it takes up carbonic acid and other waste products. This large vessel passes upward from the heart, and then curves backward in the chest to reach its roof underneath the bodies of the thoracic vertebræ, where it is continued backward to pierce the diaphragm and thus gain the abdominal cavity, in which it is continued backwards beneath the bodies of the lumbar vertebræ as far as the fifth, where it divides into two internal iliac (hypogastric) arteries, which pass backwards to supply the structures in the pelvis. In its course the aorta gives off branches to the chest walls and abdominal viscera, the chief of which are the intercostal arteries, which descend in the chest wall, one in each intercostal space; the cœliac axis or cœliac artery (see Plate IV., Fig. 5), to supply the stomach, liver, and spleen; the cranial or anterior mesenteric artery (see Plate IV., Figs. 1 and 6), to supply the small intestine, the cæcum, and the large colon; the caudal or posterior mesenteric artery, to supply the small colon; two renal arteries, to supply the kidneys; two spermatic or internal spermatic arteries (in male), to supply the testicles; or two utero-ovarian arteries (in female), to supply the ovaries and uterus; and two external iliac arteries. The last two vessels are given off from the aorta near its termination; each passes downward and outward on its own side, and leaves the abdomen behind Poupart's ligament to enter the hind-limb, where it becomes the femoral artery, which is continued downward beneath the muscles on the inner side of the thigh, to wind round behind the lower portion of the femur, to be continued as the popliteal artery. This artery is then continued down behind the stifle-joint, a short distance below which, on the posterior surface of the tibia, it divides into the anterior and posterior tibial arteries. The posterior tibial is much the smaller of the two arteries, and passes downward to the back of the hock, where it divides into the two plantar arteries; these uniting with the perforating tarsal artery, with which they are distributed to structures behind the metatarsal bones. The anterior tibial artery passes through the space between the tibia and fibula, and then descends on the anterior aspect of the tibia to reach the antero-external aspect of the hock, where it gives off the perforating tarsal artery, and is continued as the large or great metatarsal artery (lateral dorsal metatarsal artery). The perforating tarsal artery passes backward through a canal between the tarsal bones and unites with the plantar arteries. The great metatarsal (lateral dorsal metatarsal) artery runs downward first on the outer aspect of the large metatarsal bone, and later behind it (this part being distinguished as the common digital artery), and above the fetlock divides into the two digital or volar digital arteries, lateral and medial, which descend one on either side of the digit, to supply the structures within the hoof (see Plate IV., Figs. 3 and 4).

The largest branch of the aorta has not yet been mentioned—viz., the common brachio-cephalic trunk, or anterior aorta, which is given off a short distance above the heart, and carries blood for the supply of the anterior portion of the chest, the fore-limbs, and the head and neck. It is about two inches long, directed forward, and divides into the brachio-cephalic (arteria innominata) and left brachial arteries.* The former, after a short course forward, divides into the right brachial artery and the bicarotid or cephalic trunk. The bicarotid trunk very soon divides into the two common carotid arteries, which pass up the neck, one in the depth of each jugular furrow, as far as the larynx, where each divides into the external carotid, the internal carotid, and the occipital arteries. The occipital passes through the wing of the atlas to supply the muscles of the poll, and gives branches to the spinal cord and brain. The internal carotid passes into the cranium for the supply of the brain. The external carotid is much the largest of the three vessels, and passes upwards beneath the parotid gland, to divide into the

* Strictly speaking, the first part of the vessel here named "brachial" is the subclavian artery; the second part is the axillary artery; and only the terminal part is the true brachial artery.

superficial temporal and internal maxillary arteries. The former goes chiefly to the ear and upper part of the face; the latter supplies the deeper structures of the head, and is continued forward in the hard palate at the inner side of the teeth. The most important lateral branch of the external carotid is the external maxillary (submaxillary), which turns round the lower border of the lower jaw in front of its angle to reach the face, on which it is continued upwards as the facial artery. As it turns round the border of the jaw, it lies almost directly beneath the skin, so that this is a suitable position for taking the pulse.

The Brachial Arteries, right and left, carry blood for the supply of the right and left fore-limbs respectively. Each, after a short course in the chest, leaves this cavity by winding round the anterior border of the first rib, and thus reaches the limb. It then descends nearly vertically on the inner side of the muscles of the shoulder and arm, and above the lower extremity of the humerus divides into the anterior radial (collateral radial) and the posterior radial (median) arteries. The former is small, and descends in front of the radius; the latter descends behind the radius, and above the knee-joint gives off a branch to join the collateral ulnar artery, and also one which passes down on the inner aspect of the metacarpus (see Plate IV., Fig. 2), and is itself continued as the common digital or large metacarpal artery. The brachial artery gives off branches to neighbouring structures; the last of these is the collateral ulnar artery, which passes down the back of the forearm beneath the skin, is joined by a branch from the median or posterior radial, and thereafter continues downwards on the outer aspect of the metacarpus. The common digital or large metacarpal artery descends in the metacarpal region at the inner edge of the deep flexor tendon, and above the fetlock divides into the two digital or volar digital arteries, which behave like those vessels in the hind-limb.

Veins.—All the blood in the body except that in the lungs is collected by the systemic veins, which unite again and again and finally become the anterior (cranial) and the posterior (caudal) venæ cavæ, and these pour it into the right auricle of the heart. Veins generally accompany the arteries in their course, but there are certain exceptions; for instance, several subcutaneously placed veins have no corresponding or accompanying arteries, such as the two subcutaneous veins on the inner aspect of the forearm; also the saphenous vein, whose course may be followed in the living animal passing upwards over the antero-internal aspect of the hock, to be continued on the inner side of the leg and thigh. The membranes of the brain, though supplied by arteries, are not drained by ordinary veins, but by wide cavities or channels, called venous sinuses. The veins within the hoof are all arranged in networks. The jugular veins are placed in the jugular furrows; these return the blood from the head and neck, and may be regarded as the veins corresponding to the common carotid arteries. The veins coming from the spleen, stomach, and intestines unite to form the portal vein (see Plate II., Fig. 7), which carries the blood from these organs to the liver. The portal vein breaks up in the liver into capillaries, thus allowing the blood, after having collected all its nutritious material in the intestine, to be first submitted to the action of the liver. These capillaries then unite again and again in the liver tissue, until the large hepatic veins are formed, which empty into the posterior vena cava. The blood which passes to the spleen, stomach, and intestines therefore passes through two sets of capillaries before returning to the heart; one in these organs, and the other in the liver.

Lymphatic System.—In addition to the circulation of blood in the body, there is the circulation of another fluid, called lymph. This fluid is found in the tissue-spaces, bathing the tissue elements, which it probably serves to nourish as well as to drain off effete and poisonous matters. In the wall of the intestine it contains fat derived from the food; indeed, the lymph coming from the intestine during digestion is milk-like, due to the abundance of fat it contains, and is called chyle. Lymph resembles blood-plasma very closely, from which it to a large extent is doubtless derived by gradual passage of the latter through the capillary walls. No red corpuscles are present, but great numbers of leucocytes are suspended in it. It is collected by lymph capillaries, which coalesce into larger vessels, and these again into larger ones, until two main vessels, the thoracic duct and right lymphatic duct, are formed. These pour it into the blood-stream by opening into the anterior vena cava. Most of the lymph vessels accompany the veins, and at intervals along their course are nodules of lymphoid tissue, called lymph glands, through which all the lymph is filtered, so that its harmful constituents, such as bacteria, may not reach the blood. The lymph glands are for the greater part arranged in groups; for instance, beneath the skin between the two branches of the lower jaw (submaxillary group) (see Plate II., Fig. 1); in front of the anterior extremity of the sternum (prepectoral group); in the fold of skin at the groin (subiliac group); on the inner side of the thigh (deep inguinal group); and in many other situations, as well as in connection with almost all the internal organs. If infective material gains access to any part of the tissues, the nearest group of lymph glands becomes swollen and inflamed, and may even suppurate as a result of the reaction produced in combating the invading germs. This is well demonstrated in the submaxillary group of the horse in a case of strangles.

RESPIRATORY SYSTEM.

The respiratory system consists of a series of organs whose function is to convey oxygen from the atmosphere to the blood, and carbonic acid and a small amount of watery vapour from the blood to the exterior. The air passes through the nostrils into

the nasal chambers, and thence through the posterior nares into the pharynx, from which it passes into the larynx, and then down the trachea and bronchi into the lungs. The nasal chambers have already been described with the skull. The mucous membrane lining them also covers the surfaces of the turbinated bones and the cells of the labyrinth of the ethmoid bone, and is prolonged into the air-sinuses to line their walls. The air therefore passes in the nose over a very extensive area of warm moist surface, so that it is to some extent moistened and heated before passing down to the lungs. That portion of the membrane lining the posterior part of the chambers receives the filaments of the olfactory nerve, and is therefore concerned with the sense of smell.

The Pharynx (see Plate B, Fig. 1) is a short tubular passage formed of muscle, lined by mucous membrane, and leads from the posterior nares back into the larynx and œsophagus. The mouth opens into it on its floor, behind the posterior extremity of the soft palate. The opening from it into the œsophagus is placed above that into the larynx. The greater part of its floor is formed by a flap-like curtain continued backward from the hard palate, called the soft palate, which here separates it from the posterior part of the mouth. The pharynx is also a part of the alimentary canal, since the food in being swallowed must traverse it in passing from the mouth to the œsophagus. It is therefore common to both respiratory and alimentary tracts.

The Larynx (see Plate B, Fig. 1) is a short tube about four inches long which can be felt in the living animal connecting the anterior extremity of the trachea with the pharynx. Its skeleton is formed of a number of pieces of cartilage movably united to one another, and to them small muscles are attached, which bring about their movements. In its lumen are two nearly vertically placed cord-like folds of mucous membrane, one attached to either wall, called the vocal cords or folds. It is by the vibrations of these that the neighing sounds are produced. They also move during respiration, being drawn apart at each inspiration and approximated at each expiration by the actions of the muscles attached to the cartilages, so that the opening between them, known as the glottis, varies in size according to the phase of respiration. Some of these laryngeal muscles, especially those of the left half of the organ, may become paralyzed, so that the vocal cord of this side is rendered immobile; as a consequence of this, those abnormal sounds called "roaring" and "whistling" are produced. Immediately in front of the opening of the larynx is an ovate-shaped, highly elastic flap, called the epiglottis (see Plate B, Fig. 1), which closes over this opening during swallowing, and thus assists in preventing food material from entering the trachea.

The Trachea or Windpipe is a patent tube whose walls are supported by a series of incomplete cartilaginous rings. It extends from the larynx backward in the middle line on the under aspect of the neck and enters the chest. Above the posterior part of the base of the heart it divides into two branches, called bronchi, one for each lung. Each bronchus enters the root of the lung in company with the corresponding branch of the pulmonary artery, and divides into smaller bronchial tubes and these again and again into smaller ones, until the whole lung is permeated with tiny bronchioles, which ultimately end in the small air-spaces of the lung. Around these spaces the capillaries from the pulmonary artery form a network, and, as already explained in the circulatory system, the interchange of gases between the blood and air in the lung here takes place—*i.e.* the blood takes up oxygen from the air, and gives off carbonic acid gas (carbon dioxide) and watery vapour. The air in the lung-spaces, as it becomes laden with carbonic acid, is continually being renewed, a portion being driven out at each expiration, to be replaced by fresh oxygen-laden air at the next inspiration.

The Lungs (see Plate B, Fig. 7; also Plate III.A) are light, spongy, highly elastic organs which normally contain a certain amount of air in their spaces, so that a piece of normal lung will float on water. The chest cavity is divided into lateral parts, called the pleural cavities, by a partition near the median plane, called the mediastinum, which is complete in the young animal, but is perforated behind the heart in the adult and old horse. Each cavity is completely filled by the corresponding lung, and is lined by a very thin smooth membrane, the pleura, which is also reflected off from the mediastinum to completely cover the lung: that part covering the lung being in direct contact with that lining the cavity. The membrane is normally moist, and in virtue of its smoothness the friction produced during respiration between the lung and the chest wall is thus reduced to a minimum. Inflammation of this membrane is called pleurisy. No air can normally get in between the lung and the chest wall (*i.e.*, between the two layers of pleura), so that the lung must follow and accommodate itself to the movements of the chest wall; otherwise a vacuum would be produced. With every breath inward, or inspiration, the diaphragm is drawn backward and the chest walls are drawn apart, so that the lungs expand, and as a result air is drawn in through the air-passages to fill the air-spaces in the lungs. With each breath outward, or expiration, a considerable portion of the air in the lungs is squeezed out by the return of the diaphragm and chest walls to their previous position. In this way the air charged with carbonic acid and watery vapour is expelled from the lungs to make way for a fresh oxygen-laden supply. This process of respiration continues without a moment's cessation from birth to death, the expirations or inspirations numbering from 8 to 10 per minute when the animal is at rest. Respiratory movements, like all other movements of the body, are brought about by the actions of muscles. In ordinary respiratory acts the diaphragm, the intercostal muscles, and the abdominal muscles (*i.e.*, the muscles in the walls of the abdomen), come

into play, while in the deeper respirations the serratus magnus and other muscles attached to the anterior part of the chest wall are also brought into action.

THE DIGESTIVE SYSTEM.

The digestive system consists of organs which are directly concerned in the reception and digestion of food, its passage through the body, and the expulsion of the unabsorbed portion. It is so constituted as to be able to change the food into a form in which it can be incorporated into the tissues of the body. It is in the form of a long complicated tube over one hundred feet long, called the alimentary canal. It extends from the lips to the anus, and with it are associated certain glands, chiefly the liver and pancreas, whose function is to secrete digestive juices which are poured into it. Lining it throughout is a mucous membrane, which in some parts contains some of the smaller juice-forming glands. The food in this canal undergoes a process called digestion, which consists in the preparation of food in the mouth by mastication; in the chemical treatment of the food in the stomach and intestines; in the storage of the unabsorbed matters in the posterior part of the bowel; and in the passage of such matters from time to time to the exterior. That portion of the food thus rendered absorbable is taken up from the alimentary canal by the circulating blood and lymph, and carried to the parts of the body where it is useful, to be either stored there for a time or immediately incorporated into the body tissues. The transformation of digested food into the tissue elements of the body is called assimilation.

The Alimentary Canal consists of the following parts—viz., the mouth, pharynx, œsophagus, stomach, and intestine. The mouth or buccal cavity is that elongated passage between the upper and lower jaws which contains the tongue and teeth. Its upper boundary or roof is formed by the hard palate, which carries transverse ridges and is continuous behind with the soft palate. The cavity opens behind into the pharynx, and on its floor the tongue lies between the branches of the lower jaw. The teeth (see Plate D) are hard ivory-like organs arranged in two sets, an upper and lower. The roots of the former are embedded in the upper jaw, and those of the latter in the lower. In either set three kinds of teeth can be recognized (see Plate D, Figs. 1 and 2). Those in front immediately behind the lips are called the incisors; those behind, in contact with the inner surface of the cheeks, are the cheek-teeth or grinders; and those between are the canines. The incisors of each set are six in number, and arranged in a curved transverse row. The inner or that nearest to the middle line is called the first or central incisor; the next is called the second or intermediate incisor; and the outer is called the third or corner incisor. On the centre of the wearing surface or table of each is a deep fossa, called the infundibulum. The cheek-teeth of each set are arranged in two antero-posterior rows, one on either side, and are six in number (sometimes seven) in each row in the adult, named numerically from before backwards. The canines number two in each set, one on either side. They are very small or absent in the mare. During the animal's life two dentitions are recognized—viz., temporary and permanent. The teeth of the temporary dentition fall out at definite periods of life, to be replaced by permanent ones. Those of the permanent dentition, on the other hand, after being formed, are normally retained for the remainder of the animal's life, never becoming cast or succeeded by others. These, however, are not all preceded by temporary teeth, as, for instance, the posterior three cheek-teeth or molars in each row are permanent from the outset. The anterior three cheek-teeth in each row are usually spoken of as premolars, because they have been preceded by temporary teeth. At the anterior extremity of each row of premolars in the upper jaw there is very often a small rudimentary tooth, commonly called the "wolf-tooth."

The temporary incisor teeth are all fully up at two years of age. They are smaller, whiter in colour, and their necks are much better marked than in the case of the permanent teeth. The central temporary incisors are cast at two and a half years, the intermediates at three and a half years, and the corners at four and a half years, to be very soon replaced by the permanent teeth in each case. The canine teeth in the horse begin to come up at four years of age, but are not fully grown until the sixth year (see Plate D, Fig. 9). All the teeth of the horse continue to grow for the greater part of the animal's life, so that wear and growth go on simultaneously, and are responsible for those changes in form and appearance which the teeth undergo with the passage of years. These changes, as well as the stated times of casting of the temporary teeth and eruption of the permanent ones, are made use of in the estimation of the animal's age. Thus, the incisor teeth become more horizontal in direction and more cylindrical in shape as age advances, and the infundibula begin to disappear from the central incisors at six years, from the intermediates at seven years, and from the corners at eight years.

The food is first taken into the mouth by means of the lips and incisor teeth, and is then carried backwards by the movements of the jaws, cheeks, and tongue to be thoroughly ground by the cheek-teeth and saturated with a fluid, called saliva, which is poured into the mouth by the salivary glands. This fluid is alkaline in reaction, and contains a ferment called ptyalin, which acts on some of the insoluble starch in the food and converts it into soluble sugar. Some authors, however, deny the presence of this ferment in the saliva of the horse. There are three main pairs of saliva-forming glands—viz., the parotid, the submaxillary, and the sublingual. The first is much the largest, and can be manipulated during life below the ear

between the lower jaw and the wing of the atlas (see Plate B, Fig. 3).

The food-pulp thus formed after mastication is gathered into a bolus and swallowed. The bolus first passes over the back of the tongue, to be seized by the muscles of the pharynx, which carry it over the opening of the larynx into the œsophagus. During this act the opening of the larynx almost closes, and the epiglottis is driven backward by the bolus over the entrance to the larynx, so that food material is prevented from entering the windpipe. The bolus is thence carried down the œsophagus by a wave-like contraction into the stomach.

The Œsophagus or Gullet passes backwards in the under aspect of the neck above the trachea, then through the chest in the mediastinum above the heart, to pierce the diaphragm and enter the stomach. In the posterior part of the neck it lies nearly in contact with the skin in the left jugular furrow, so that here the movement of the bolus of food can be seen as it passes down during swallowing.

The Stomach (see Plate II., Figs. 3, 4, and 5) is remarkably small, with a capacity of 2 to 4 gallons, and is in the form of a curved sac placed immediately behind the liver and diaphragm. Its right extremity is narrow and called the pylorus, and becomes continuous with the duodenum. Waves of contraction are constantly passing over its walls, so that the food, which is here arrested for some time, becomes rolled and churned until saturated with gastric juice. The mucous membrane (see Plate II., Fig. 4) lining its left half is white in colour and identical with that in the œsophagus, while that of the right half is reddish-brown in colour, and contains numerous small glands which secrete an acid secretion, the gastric juice. These two parts of the mucous membrane are separated by a well-defined line. *The gastric juice* contains two ferments, called pepsin and rennin. Pepsin has the power of changing some of the proteid constituents of the food into more soluble and diffusible substances, called peptones, while rennin has the power of making milk clot, and rennet, which is used in the production of cheese, is merely a solution containing this ferment derived from the stomach of the calf. After the food has been treated in the stomach in this way for some hours, it is passed into the first part of the intestine in a semifluid form, called chyme.

The Intestine is a very long tube whose walls are formed of involuntary muscle lined with mucous membrane, and it extends from the stomach to the anus. It occupies most of the space in the abdominal cavity, and is divided into two main portions, the small and the large intestine.

The Small Intestine (see Plate III.a) connects the stomach with the large intestine, and is about 70 feet long, with a diameter of 2 to 4 inches. It lies for the greater part in contact with the left abdominal wall above the large intestine. Its first 3 or 4 feet is fixed to the abdominal wall by a narrow peritoneal fold, and is called the duodenum (see Plate II., Fig. 3), while the remaining portion is suspended to the abdominal roof by a very broad fold of peritoneum, called the mesentery, so that this latter portion is allowed a considerable range of displacement within the abdomen, and may even reach the abdominal floor. The mucous membrane of the small intestine contains glands whose secretion (succus entericus) assists the pancreatic juice in its digestive action on the food.

The Large Intestine extends from the small intestine to the anus, and is about 25 feet in length. It differs from the small intestine in that its walls are puckered, owing to the presence on them of longitudinal muscular bands which appear to be too short for the bowel wall. It consists of the cæcum, the double colon, the small colon, and the rectum.

The Cæcum (see Plate IV., Fig. 6; also Plate II., Fig. 6) is conical in shape, with a capacity of 7 or 8 gallons. Its contents have always a fluid or watery character, and it is therefore often termed the water-bag of the horse. Its base is attached to the abdominal roof in the right lumbar region, and is in contact with the abdominal wall at the right flank. Here the small intestine opens into it, and the large colon opens out of it. Its apex is blind, and lies on the abdominal floor behind the posterior extremity of the sternum. There is no vermiform appendix, as in the human subject.

The Large or Double Colon (see Plate IV., Fig. 6; also Plate II., Fig. 6) is by far the most voluminous portion of the bowel in the horse. It is 10 to 12 feet long, with a capacity of about 16 gallons, and consists of two parallel portions of bowel, which are closely attached to one another, and lie one above the other. The bend where these two portions become continuous lies at the entrance to the pelvis, and is called the pelvic flexure. When in position within the abdomen, this double column of bowel is bent on itself behind the liver and diaphragm, thus forming two other flexures (see Plate II., Fig. 6; also Plate III.a). One half of it lies in contact with the right abdominal wall and the other with the left. For descriptive purposes it is divided by these flexures into four portions, which are named according to their positions (see Plate II., Fig. 6). It is fixed to the roof of the abdomen near the base of the cæcum only at its beginning and termination, so that it is for the greater part free or non-attached, and there is thus possible a great range of displacement within the abdomen. As a consequence of this arrangement the gut sometimes becomes twisted on itself, producing a severe form of colic and fatal results.

The Small Colon (see Plate III.a) leads from the termination of the double colon to the rectum, and is about 10 to 12 feet long. It is suspended to the abdominal roof by a broad fold of peritoneum, called the small or colic mesentery, which is very similar to the mesentery of the small intestine. It has almost the same position in the abdomen as the small intestine, which it resembles in size, but from which it can easily be distinguished by the presence on its walls of two longitudinal bands and

numerous puckerings. These puckerings are best marked towards its termination, where they cause the balling of the fæces.

The Rectum (see Plate III.A) is placed in the pelvis, is about 1 foot long, and leads from the small colon to the exterior, where it opens on a prominence beneath the root of the tail, called the anus. Its posterior portion is dilated, and acts as a reservoir for fæces before these are passed out.

The Abdominal Cavity, as well as part of the pelvis, is lined by a thin, smooth, semitransparent membrane, called peritoneum,* which is similar to the pleura of the chest, and, like it, is reflected from the wall to entirely cover all the viscera in the cavity, so that the surfaces of all the abdominal organs and most of those in the pelvis are smooth and glistening, as a result of which friction between them and the abdominal wall is reduced to a minimum.

There are two very important glands in the abdomen whose secretion is poured into the duodenum and plays an important rôle in digestion. These are the liver and pancreas.

The Liver (see Plate II., Fig. 3; also Plate B, Fig. 6, and Plate III.A) is a solid organ about 11 pounds in weight, and placed against the posterior surface of the diaphragm. It is divided into three main lobes, a central and two lateral. Its secretion, known as bile, is carried by the bile-duct into the duodenum, where it aids in digestion by assisting in emulsifying fat—*i.e.*, by dividing it into fine particles suspended in fluid. The horse differs from most animals in having no gall-bladder. Besides the function of secreting bile, the liver serves another important function as a storehouse for sugary substances brought by the blood from the intestine. As already explained, the liver is the first organ to receive the blood after coming from the intestine, and this blood, which is carried by the portal vein, is very rich in sugar. The liver has the power of taking up this sugar and some other substances from the blood to form glycogen, a starchy substance, which it stores in its cells and doles out to the other tissues of the body as required.

* Inflammation of this membrane is called peritonitis.

The Pancreas (see Plate II., Fig. 7) is a much smaller gland, of a yellowish colour, placed at the roof of the abdomen above and behind the stomach. Its right portion is broad and called the head, while its left portion is narrow and stretches across to the left side towards the spleen, and is called the tail. Its secretion, the pancreatic juice, is carried by two ducts into the duodenum; one opens in company with the bile-duct. The pancreatic juice is the most important of the digestive juices, since it contains amylopsin, a ferment which changes starch into soluble sugar; trypsin, a ferment which changes proteids into more soluble and diffusible substances, called peptones; and lipase, a fat-splitting ferment which splits up fat into glycerine and fatty acids. The acid chyme, after coming from the stomach into the duodenum, is immediately made alkaline by the bile and pancreatic juice, and all the starch and proteids which have not been already changed by the saliva and gastric juice are powerfully acted on and for the greater part rendered absorbable by the amylopsin and trypsin of the pancreatic juice, aided by the secretion from the wall of the intestine (succus entericus); while the fat is prepared for absorption both by the lipase of the pancreatic juice and by the bile. While these processes are going on in the small intestine, its contents are being gradually carried along its lumen by the wave-like contractions of its walls. The absorption of most of the products of digestion takes place towards the posterior part of the small intestine. Here the cells lining the bowel take up those constituents of the food which have been rendered absorbable by the digestive processes and transfer them to the blood-stream, but in case of the fats to the lymph-stream.

The large intestine, on account of its large capacity, has usually been regarded as a reservoir for food material rather than an active centre of digestion, but there can be no doubt that very important digestive processes go on in it. There are no digestive juices other than that from its walls (succus entericus) poured into it, and it is always almost filled by semi-fluid ingesta, which are here retained for a considerable time. It is actively employed in dealing with cellulose,* not by means of any known ferment, but rather by a process of maceration, decomposition, and bacterial disintegration, which render this substance fit for absorption. As a result of this process carbonic acid and marsh gas are formed. In addition, other putrefactive processes take place here; bacteria are engaged in attacking the unabsorbed products of proteids digestion, and reducing them to simpler substances, such as amido-acids, indol, skatol, etc., which are either got rid of through the fæces or absorbed into the blood and excreted by the kidneys. Absorption from the small colon and rectum is rapid, so that their contents are always relatively firm and dry.

THE EXCRETORY SYSTEM

(See Plate IV., Fig. 7).

As a result of the active chemical changes in the body tissues, various impure and harmful substances are formed, which must be got rid of in order that health and life may be maintained. This riddance is accomplished by the excretory system, a group of organs embracing the kidneys, the lungs, and the skin. Most of the nitrogenous waste of the tissues, consisting chiefly of urea and hippuric acid, is excreted, together with water and soluble salts, by the kidneys and skin; while carbonic acid gas, as well as a small amount of watery vapour, is exhaled by the lungs, as already explained. The amount of urea and salts thrown out by the skin is so small as to be almost negligible, but, on the other hand, the water it extrudes may be much, as

* Cellulose is a material of a woody nature which forms the cell walls of plants.

in hot weather, or little, as in cold. The chief excretory organs, then, are the kidneys, for it is by them that the greater part of the superfluous water and practically all the urea, hippuric acid, and soluble salts are taken from the blood and passed into the urinary tract, which conducts the urine thus formed to the exterior.

The Kidneys (see Plate II., Fig. 2; also Plate B, Fig. 8) are two in number, a right and left, placed at the roof of the abdomen outside the peritoneum, one on either side of the vertebral column, beneath the upper portions of the last two or three ribs and the first two or three lumbar transverse processes. The right, however, is always a little farther forward than the left. They are always surrounded by a considerable quantity of fat. Each is roughly crescentic in outline, and weighs from 20 to 28 ounces. On the inner or concave border is a depression, the hilus, where the renal artery enters and the renal vein and ureter leave the organ. Immediately in front of the hilus is a small oval organ, the suprarenal body (adrenal), but this has no connection with the excretory system. On horizonal section the kidney is seen to be surrounded by a membranous capsule, and composed of three chief portions—viz., an outer dark zone, the cortex; an inner paler zone, the medulla; and the pelvis of the kidney, which is a small cavity placed opposite the hilus to the inner side of the medulla, and is simply the origin of the ureter. The kidney consists chiefly of very minute tubules, which begin in the cortex with dilated ends, Bowman's capsules, and end in the pelvis of the organ. Entering each capsule is a very minute afferent Bowman's artery, which divides into loops of capillaries, forming a small tuft in the capsule. A small efferent vessel leaves the capsule to form a network around the beginning of the tubule. It is through the walls of these minute arteries that the kidney tubules receive water and waste products from the blood. The urine thus formed is poured by the tubules into the pelvis of the kidney, whence it trickles into the ureter, a small tube that carries it to the bladder. The bladder is a muscular nearly conical sac which acts as a reservoir for urine. It lies on the floor of the pelvis, and its broad extremity may project slightly into the abdomen. The urine collects in the bladder until it is convenient to pass it to the exterior, when the muscular walls of this organ contract in response to nervous impulses, and the urine is thus forced into the urethra, a tube that leads away from the bladder. In the female the urethra is short, and opens on the floor of the vulva about 5 inches from the outer opening of the latter. Lying over the opening of the urethra on the floor of the vulva is a small valve-like transverse fold of mucous membrane, the free edge of which is directed backwards. In the male the urethra is very long and narrow, turns round the sciatic arch, and passes forwards in the substance of the penis to open to the exterior at the free extremity of that organ.

The Skin.—The skin is a protective organ, for it covers all the external parts of the body. It is also an organ of touch, as well as a secretory organ for water and certain soluble substances, and it transmits a small amount of carbonic acid gas from the blood to the exterior. It plays a very important rôle in regulating the heat of the body. This function it carries out by means of the sweat which is secreted by its sweat glands. When the body is heated perspiration follows, and as the sweat evaporates the surface of the skin and the blood in the superficial vessels are cooled. Even when no sweat is visible, the skin is continually giving off invisible water vapour, and with it heat, in order to keep the temperature of the body uniform. In the skin two chief layers can be recognized—the epidermis and the dermis, or true skin. *The epidermis* is on the exterior, and consists of several layers of closely packed cells, with the cells of the superficial layers flattened and horny. The hairs, chestnuts, and hoofs are modified portions of the epidermis. *The dermis, or true skin*, is beneath the preceding, and consists of connective tissue, which contains the glands, bloodvessels, lymphatic vessels, and nerves of the skin. The nerves are numerous, and their endings in the skin are endowed with the power of conveying sensations of touch. The glands of the skin are of two kinds, sweat glands and sebaceous glands. The sweat glands have the power of taking up water, soluble salts, and a little urea from the blood, and passing them to the surface as sweat. They are least numerous on the limbs. The sebaceous glands secrete a grease-like material, which serves to keep the hairs moist. The skin is almost entirely covered with short hairs (see Plate I.A), which grow to a definite length, and which form a coat or covering for the body. These are cast off twice yearly—namely, spring and autumn—to be replaced by new hairs. Those forming the winter coat are much longer than those of the summer one. On the upper border of the neck (mane) and on the tail and back of the fetlocks are long hairs, which grow to an indefinite length. These, as well as the long tactile hairs on the lips and eyelids, are not cast off at definite periods, as is the case with the short hairs. Each hair grows from a pit of its own in the skin, called the hair follicle, into which the ducts of its sebaceous glands open. The chestnuts are horny excrescences found on the inner aspect of each forearm and hock.

THE REPRODUCTIVE OR GENITAL SYSTEM.

In many of the lower types of animals both sets of reproductive organs, male and female, are found in the same animal, but in all the higher species the male organs are carried by one animal and the female by another. Besides the obvious and striking anatomical differences between the two sexes that this segregation of reproductive organs presents, there are several other points—such as the form of the pelvis, the power and con-

formation of some of the muscles, especially those of the neck—which serve as distinctions between the horse and the mare. In both horse and mare the urinary and genital tracts join one another towards their terminations, for in the mare the urine is poured into the vulva, and in the horse the secretion of the testicles is poured into the urethra near its beginning (see Plate B, Fig. 9). The male genital or reproductive organs consist of the two testicles, two deferent ducts, the penis, containing the male urethra, and the accessory sexual glands.

The Testicles or Testes (see Plate III.A) are the essential reproductive organs of the male, since they produce the spermatozoa. They are ovoid in shape and situated in the inguinal region, enclosed in a diverticulum on the abdominal floor, called the scrotum. In the fœtus the testicles are developed at the roof of the abdomen behind the kidneys, and as growth proceeds they gradually migrate from this position and finally pass down the inguinal canals, each carrying with it a pouch of peritoneum, into the scrotum. This migration from the abdomen to the scrotum occurs usually during the first year of life or sometimes shortly before birth. Sometimes, however, one or both testicles are retained in the abdomen or inguinal canal throughout life —*i.e.*, they never reach the scrotum. Such an animal is called a "rig" or "cryptorchid." Each testicle is suspended in the scrotum by the spermatic cord. This cord is flattened and broad. Its anterior border is thick, rounded, and cord-like, and contains the spermatic vessels, and is therefore called the vascular portion of the cord. The testicle and cord are covered by a protrusion of peritoneum, which is reflected on to the inner surface of the wall of the scrotum.

The Vas Deferens or Deferent Duct (see Plate III.A; also Plate B, Fig. 10) is a small tube which carries the semen from the testicle upwards in the spermatic cord through the inguinal canal, to pour it into the first part of the urethra. Between the testicle and the deferent duct is a very flexuous, convoluted tubular mass which lies on the upper border of the testicle, called the epididymis. The semen is carried along the urethra by the contractions of its constrictor muscles, to be poured into the vagina of the female during copulation. Its flow along the urethra is facilitated by the secretions of the accessory sexual glands, which are poured into the first part of the urethra. These glands (see Plate B, Fig. 10) are two vesiculæ seminales, two bulbo-urethral (Cowper's) glands, and the prostate gland. They are all placed on the floor of the pelvis in contact with the intrapelvic portion of the urethra.

The Penis (see Plate B, Figs. 11 and 12) is the male organ of copulation, is composed essentially of erectile tissue, and is traversed throughout its length by the urethra. It is somewhat cylindrical in shape, and extends from the sciatic arch forwards between the thighs to the sheath. The free portion—*i.e.*, that part which is protruded from the sheath during erection—carries at its extremity a prominent rim, rendering this extremity somewhat like the rose of a watering-can in shape, especially when the organ is erect. This extremity is usually called the glans penis. When the organ is non-erect, the free portion is accommodated in a double tubular fold of skin, called the sheath or prepuce, placed a short distance in front of the scrotum. The posterior extremity of the penis is bifid and is attached to the sciatic arch. Each attachment is surrounded by an ischio-cavernosus (erector penis) muscle. When cut into, the erectile tissue composing the organ is seen to be sponge-like; its meshes or spaces containing blood, which is drained away by the veins of the penis. When the erector penis muscles contract, which they do in response to nervous stimuli, the veins leaving the organ are compressed at the sciatic arch, and as a result of this the blood-spaces of the penis become distended with blood, thus bringing about erection. The semen which is poured into the vagina of the female during copulation contains innumerable very minute, active, wriggling particles of protoplasm, called spermatozoa, which appear like small tadpoles under the microscope. These find their way by their movements into the uterus and uterine (Fallopian) tubes, and generally in the latter, if an ovum is present and circumstances are favourable, fertilization takes place—*i.e.*, the ovum is penetrated by a spermatozoon, as a result of which it undergoes a series of divisions, which result in the production of the embryo or fœtus.

THE NERVOUS SYSTEM

(See Plate V., also Plate V.A).

All the different organs of the body, performing their various functions, are presided over and controlled by the brain, acting through a series of string-like prolongations, the nerves, which pierce almost every tissue in the body, and which consist of bundles of fine fibres. Some of these nerves carry information to the brain as to what is required by the several tissues (sensory or afferent nerves); others carry impulses from the brain and direct the tissues what action to perform (motor or efferent nerves); while many are mixed, containing both sensory and motor fibres. The brain, therefore, by means of the nerves, controls all the movements and changes in size, shape, and direction of the tissues and fluids of the whole body; for instance, by its action the rhythmical movements of the heart and respiratory organs are carried on, as well as the voluntary movements of the limbs; also the unconscious working of the digestive organs and the intelligent perception of the special senses of seeing, hearing, smelling, touching, and tasting. For descriptive purposes the nervous system may be divided into three portions —viz., central, peripheral, and sympathetic.

The central nervous system is made up of the brain and spinal cord.

The Brain (see Plate V., Figs. 2 and 3) is situated in the

cranial cavity, and is continuous with the spinal cord through the foramen magnum. It is relatively small, being only about 23 ounces in weight. Its surface is very irregular, carrying numerous furrows separated by ridges, called convolutions which run in all directions. The largest and most important portion of the brain consists of the two cerebral hemispheres, a right and left, separated by a deep fissure. These contain the higher nerve centres, which control most of the lower centres, and through them the organs of the body. Behind these hemispheres is a much smaller, somewhat cauliflower-like mass of nervous tissue, the cerebellum, which is chiefly concerned in maintaining the equilibrium of the body. Lying below this is an elongated body, the medulla oblongata, which is continuous with the spinal cord at the foramen magnum. The medulla is the seat of numerous small centres which directly control vital actions such as respiration, circulation, the secretion of such glands as the salivary glands, and other important processes. Most of the nerve fibres, in passing from either side of the medulla oblongata into the spinal cord, cross the middle line to be continued in the opposite side of the cord, and supply the opposite half of the body, so that the right half of the brain, for the greater part, supplies the left half of the body, and the left half of the brain the right half of the body.

The Spinal Cord is placed in the vertebral canal, and extends from the skull to the sacrum. In its centre is the tiny central canal which is in communication with the small cavities in the brain, called the ventricles. The spinal cord is the path by which most of the nerves of the body are connected with the brain, all of them, except twelve which issue directly from the brain, proceeding directly or indirectly from the cord. Besides this, in the spinal cord itself are some of the lower centres controlling such actions as urination and defæcation. The brain and cord are wrapped in three membranes (dura mater, arachnoid, and pia mater), between which is a small amount of fluid, forming a kind of water-bath and therefore preventing jar.

The Sympathetic Nervous System is that part of the general nervous system which transmits impulses, none of which are under the animal's voluntary control, to the bloodvessels and internal organs. This system consists of two gangliated cords of nervous tissue extending from the head to the sacrum, one on either side of the vertebral column. In the neck the cord on either side is in company with the vagus nerve in the bottom of the jugular furrow. The cords receive small branches from the spinal nerves after the latter issue from the spinal cord and give off small branches which ultimately end in the viscera and bloodvessels. In the chest and abdomen the enlargements or ganglia on either cord are numerous, one opposite each vertebra, but in the neck there are only three, one at the skull and two immediately the cord enters the chest.

The Peripheral Nervous System (see Plate V., Fig. 1) consists of a series of nerves given off from the brain and spinal cord. These nerves sooner or later break up into branches, and these again and again into smaller ones, until almost every tissue in the body is reached. They therefore place the central nervous system in communication with all the body tissues. A few of the most important of these may here be described. From the brain twelve pairs of cranial (cerebral) nerves are given off mainly for the supply of the head. The first or olfactory pair supply the mucous membrane of the posterior part of the nose, and are concerned in the sense of smell; the second or optic end in the retinæ, and are concerned in the sense of sight; the third or oculo-motor, the fourth or trochlear, and the sixth or abducent, all supply the muscles of the eyeball; the fifth or trigeminal on each side divides into the ophthalmic, the maxillary, and the mandibular, for the supply of sensation to the mouth, lips, eyelids, teeth, and the greater part of the tongue; also motor fibres for the supply of the muscles which close the mouth; the seventh or facial supply the muscles of the face, lips, and ear, and the greater part of each nerve lies on the masseter muscle directly beneath the skin; the eighth or acoustic (auditory) end in the internal ear, and are concerned in hearing and equilibration of the body; the ninth or glosso-pharyngeal supply some of the muscles of the pharynx and sensation to the posterior part of the tongue. Each tenth nerve or vagus passes down the neck in the bottom of the jugular furrow in company with the sympathetic cord, then backwards in the chest, to end ultimately in the stomach and part of the intestine. It supplies the larynx, heart, lungs, œsophagus, stomach, and part of the intestine. The motor branch which ends in the larynx is called the recurrent nerve, and is given off from the vagus in the chest and passes upwards in the neck beneath the trachea to supply the muscles of the larynx. The left is given off from the vagus, above the heart, farther back than the right, and is the nerve which is nearly always the seat of disease in an animal which is a "roarer" or "whistler." The eleventh or accessory pair of cranial nerves pass backwards on the side of the neck, and supply the sterno-cephalicus and trapezius muscles; the twelfth or hypoglossal pair supply the muscles of the tongue.

The Spinal Nerves are arranged in pairs, of which there are usually forty-two. They are named according to their relations to the vertebral column, as cervical, dorsal or thoracic, lumbar, sacral, and coccygeal, and they pass out from the vertebral canal in series between the vertebræ. Each nerve springs from the spinal cord by two roots, upper (dorsal) and lower (ventral). The former carries a small enlargement or ganglion, and consists chiefly of sensory fibres, while the latter contains chiefly motor fibres and has no ganglion. The cervical nerves (see Plate V.A) supply chiefly the muscles of the neck; the thoracic nerves the muscles of the back and chest; the lumbar nerves the muscles of the loins and abdominal walls; and the coccygeal nerves the muscles of the tail. The nerve-supply for the fore-limb comes

from the brachial plexus, and that for the hind-limb from the lumbo-sacral plexus. *The brachial plexus* (see Plate V., Figs. 1 and 4) is a broad bundle of nerve fibres placed at the anterior border of the first rib, and formed by the union of large branches from the sixth, seventh, and eighth cervical and first two thoracic nerves. From it nerves are given off for the supply of the fore-limb. The three largest and most important of these are the radial, ulnar, and median. *The radial or musculo-spiral nerve* descends first on the inner aspect of the shoulder, and then passes out behind the humerus to descend on the outer surface of this bone and divide into branches for the supply of the muscles which extend the elbow, knee, fetlock, pastern, and coffin joints. *The ulnar nerve* descends first on the inner aspect of the arm, then on the posterior aspect of the forearm beneath the skin and fascia, and joins a branch from the median to form the lateral (external) volar metacarpal nerve. The ulnar nerve supplies some of the muscles on the posterior aspect of the forearm. *The median nerve* descends first on the inner aspect of the arm, then over the inner aspect of the elbow-joint in company with the median artery, to be continued in the forearm immediately behind the radius. A short distance above the carpus it divides into the medial (internal) volar nerve of the metacarpus and the before-mentioned branch which joins the ulnar. It supplies the biceps brachii and the brachialis muscles, also most of the muscles at the posterior part of the forearm. The volar nerves of the metacarpus are two in number, external and internal (lateral and medial). They descend in the metacarpal region, one at either edge of the deep flexor (flexor perforans) tendon, to reach the side of the fetlock, where each divides into two or three digital nerves. About the middle of the metacarpus the inner gives off a small communicating branch, which passes obliquely downwards and outwards beneath the skin to join the outer volar nerve. The digital nerves (see Plate V., Figs. 6 and 7) descend at the side of the digit, and supply the digit and structures within the hoof. The posterior is much the largest. *The lumbo-sacral plexus*, like the brachial, is formed by the union of nerves which here come from the last three lumbar and the first two sacral nerves. It lies at the side of the bodies of the last two lumbar vertebræ and first part of the sacrum. From it branches are given off to the hind-limb; the chief of these are the femoral, the obturator, the gluteals, and the great sciatic. *The femoral or anterior crural* passes down behind Poupart's ligament to supply the quadriceps femoris muscles which lie in front of the femur. It gives off the saphenous nerve, which descends on the inner side of the thigh. *The obturator nerve* passes downwards on the side of the pelvis, and passes through the obturator foramen to supply most of the muscles on the inner side of the thigh. *The gluteal nerves* supply chiefly the gluteal muscles. *The great sciatic nerve* is by far the largest branch of the plexus. It leaves the pelvis by the great sciatic foramen, and then descends into the thigh behind the hip-joint, to divide into the tibial and common peroneal nerves. *The common peroneal nerve* (external popliteal nerve) descends beneath the biceps femoris muscle behind the femur to reach the outer aspect of the stifle-joint, where it divides into the superficial peroneal nerve (musculo-cutaneous nerve), which descends beneath the skin of the leg, and the deep peroneal nerve (anterior tibial nerve), which descends on the tibialis anterior muscle in front of the tibia to supply the muscles in this vicinity and the hock. *The sural nerve* (external saphenous) is given off from the tibial about the middle of the thigh, and descends beneath the skin in front and to the outer side of the tendo Achillis. *The tibial nerve* (posterior tibial nerve) descends first behind the thigh and stifle, then in the leg beneath the skin in front, and to the inner side of the tendo Achillis, and a little above the hock it divides into the two plantar nerves. It supplies the muscles at the back of the tibia.

The plantar nerves, external and internal (lateral and medial), descend first behind the hock, to which they give some branches, then in the metatarsal region, one at either side of the deep flexor (flexor perforans) tendon. They afterwards behave in a similar manner to the metacarpal nerves of the fore-limb. A small oblique branch passing from the internal to the external is often present, as in the fore-limb.

THE SPECIAL SENSE ORGANS.

The animal, through the brain, is made and kept aware of what is happening in the external world by means of the special senses of sight, hearing, taste, and smell. The special sense organs are adapted for the reception of impressions from the outer world, and for their transmission through nerves to the brain. For example, images cast on the retina of the eye induce nerve impulses which are conveyed to the brain by the optic nerve. The message is there received by that (posterior) part of the cerebral hemisphere which is concerned in the function of sight.

The Organs of Vision.

The sense of sight depends upon the special mechanism of the eyes (see Plate B, Fig. 5). The eye proper, or eyeball, is almost spherical in shape, placed in the orbital cavity, and consists of three concentric coats or membranes lying one over the other. It can be moved in any direction by means of special muscles which are attached to it, and posteriorly the optic nerve passes from it to the brain. In front it is protected by two freely movable curtains, the eyelids, and there is also in front and to its inner side a fold of mucous membrane containing a piece of cartilage, called the third eyelid or membrana nictitans. The inner surface of both eyelids is lined by a pinkish-coloured mucous membrane, the conjunctiva. Beneath the bone above the eyeball is the lachrymal gland, which secretes a fluid (tears)

which flows down over the front of the eyeball to enter two small canals at the inner angle of the eyelids. These canals lead into a duct (ductus ad nasum) which passes down on the outer wall of the nasal cavity to open into the nasal chamber about 3 inches above the lower angle of the nostril. This opening can be seen within the nostril as a small punched-out mark on the skin. The outer coat of the eye-ball consists of the sclerotic and cornea. The former (white of the eye) is white, thick, and dense, and forms the posterior four-fifths of this coat; the latter is transparent, colourless, and non-vascular, and forms the anterior fifth of the outer coat. The middle coat is highly vascular, and for the greater part black in colour. Its posterior four-fifths consists of the choroid, and its anterior fifth is formed by the iris. Towards the posterior part of the choroid is a somewhat triangular area (tapetum lucidum) presenting an iridescent lustre, passing from a brilliant green to a deep blue. The choroid is continuous in front with the iris, which is of a dark brown colour and projects into the eyeball behind the cornea as a curtain or diaphragm in front of the lens. In the centre of the iris is an oval opening, the pupil, which can be varied in size by the action of muscle fibres in the substance of the iris; thus the amount of light passing through the pupil to the lens is regulated. Sometimes the iris is non-pigmented and of a greyish colour, constituting the so-called "wall eye" of the horse. The inner coat of the eyeball is the retina. It is delicate, transparent, and lies on the inner surface of the choroid. It is in close connection with the optic nerve, and the pictures which are thrown on it through the lens are transmitted by that nerve to the brain for perception. Just behind the pupil is the lens, a clear crystalline structure, with which is indirectly associated a tiny muscle capable of altering the shape of the lens, so as to focus certain rays of light on the retina. The eye therefore acts like a photographic camera, since its lens serves to focus the image on the retina, which corresponds to the plate in the camera, and the iris acts the part of the diaphragm in regulating the amount of light passing into the eye. The space between the cornea and the anterior surface of the lens is filled by a clear watery fluid, the aqueous humour. That large space behind the lens and surrounded by the retina is occupied by a clear, jelly-like material, the vitreous humour. On looking into the eye, the iris, pupil, and anterior surface of the lens can be easily seen through the cornea.

The Auditory Apparatus.

The sense of hearing depends upon a special mechanism by which vibrations of sound are converted into impulses, which are transmitted by the acoustic or auditory nerve to the brain, where they are brought to consciousness. Each ear consists of three parts, distinguished as the external ear, the middle ear, and the internal ear. *The external ear* (see Plate B, Fig. 3) consists of a freely movable trumpet-shaped piece of cartilage, and of a small bony tube (external auditory meatus) leading from this trumpet-like cartilage to the tympanic membrane. The movable portion of the external ear is covered by skin on both surfaces, and is often called the pinna. Its opening can be directed towards the source of the sound by the actions of the special muscles which are attached to it. *The middle ear or tympanum* is a small cavity of irregular shape in the petrous temporal bone, and is separated from the external ear by the tympanic membrane (drum). This membrane stretches across the bottom of the external auditory meatus to which its border is attached. Stretching across the middle ear is a chain of three very small bones (malleus, incus, and stapes) extending from the tympanic membrane to the internal ear. Leading from the middle ear to the pharynx is the Eustachian tube, which in the horse is not complete, being for the greater part in the form of a deep groove or gutter which opens directly into a large air-sac, the guttural pouch, placed beneath the base of the cranium. *The internal ear or labyrinth* is a small and very complex structure placed to the inner side of the middle ear in the petrous temporal bone. It is the essential part of the organ of hearing, and consists of three main portions, the cochlea, the vestibule, and three semicircular canals. It contains a lymph-like fluid in which small calcareous bodies float. The external ear serves to collect the sound waves and transmit them to the tympanic membrane, which is thus set into vibration. These vibrations are carried across the middle ear by the already mentioned chain of bones, and transmitted to the internal ear, in which the lymph-like fluid and calcareous particles are, as a result, set in motion. By means of the motion of this fluid and its contained particles the vibrations are communicated to the endings of the fibres of the auditory nerve, which carry an impulse to the brain. The cochlea is chiefly concerned in hearing, while the semicircular canals and vestibule are concerned chiefly with the equilibration of the body.

The Sense of Taste.

Some of the fibres of the fifth and ninth cranial nerves which supply the mucous membrane of the mouth, chiefly that of the tongue, end in small special organs, called taste buds, which are the chief organs concerned in the sense of taste.

The Sense of Smell.

The organ of smell is in the mucous membrane of the posterior part of the nasal cavity—*i.e.*, that portion to which the olfactory nerves are distributed.

The Ductless Glands.

Ductless Glands are glands whose products are carried from them, not by ducts, but by the bloodvessels or lymph vessels leaving them. The chief of these are the spleen,* the thymus

* The spleen is included among the ductless glands for convenience only. Unlike the other glands, it produces cellular elements which are added to the blood.

gland, the thyroid gland, the adrenal glands, and the pituitary body.

The Spleen (see Plate III.A) is not, strictly speaking, a gland, since it contains no true gland tissue (epithelial tissue). It is a sickle-shaped, greyish-coloured organ placed to the left of the stomach under cover of the last eight or nine left ribs. Its base is directed upward, and is attached to the lower aspect of the left kidney. It is about 20 inches in length, and usually from 2 to 3 pounds in weight. It forms some of the white blood-corpuscles, and it breaks down the worn-out red blood-corpuscles and thus liberates their pigment, which is carried to the liver.

The Thymus Gland is only well developed in the very young animal, since it atrophies with age until it entirely disappears. It persists, however, much longer if the horse is castrated when young. It is placed on the floor of the chest in front of the heart.

The Thyroid Gland consists of two oval lobes, each about 1 inch long, placed one on either side of the anterior extremity of the trachea, and connected with one another below the trachea by a narrow band or isthmus.

The Adrenal Glands or Suprarenal Bodies (see Plate II., Fig. 2) are two small oval bodies placed one in front of the hilus of each kidney.

The Pituitary Body or Hypophysis Cerebri (see Plate V., Figs. 2 and 3) is a small disc-shaped body placed on the floor of the cranium beneath the brain.

The secretions of the ductless glands have a powerful influence over the tone of the vascular system and the nutrition of the body tissues generally.

DESCRIPTION OF PLATES

PLATE A.

FIG. 1.—ELBOW-JOINT SEEN FROM THE INNER SIDE.

1. Humerus.
2. Ulna.
3. Insertion of biceps brachii muscle.
4. The deep or short portion of medial (internal) collateral ligament of elbow.
5. Insertion of brachialis muscle.
6. The long or superficial portion of medial (internal) collateral ligament of elbow.
7. Transverse or arciform ligament.
8. Radius.

FIG. 2.—CARPAL OR "KNEE" JOINT SEEN FROM THE FRONT, SHOWING THE SMALL BONES AND LIGAMENTS.

1. Radius.
2. Deep fasciculus of medial (internal) collateral ligament attached to the radial carpal bone.
3. Lateral collateral ligament.
4. Two anterior or dorsal bands: the upper or proximal connecting the radial and intermediate carpal bones; the lower or distal connecting the third and fourth carpal bones.
5. Two oblique bands extending from the third carpal to the third (large) metacarpal bone.
6. The third metacarpal bone (cannon bone).

FIG. 3.—FRONTAL SECTION OF THE CARPAL OR "KNEE" JOINT.

1. Radius.
2. Intermediate carpal bone.
3. Ulnar carpal bone.
4. Radial carpal bone.
5. Lateral collateral ligament.
6. Medial collateral ligament.
7. Fourth carpal bone.
8. Second carpal bone.
9. Third carpal bone.
10. Fourth metacarpal bone (outer splint bone).
11. Third metacarpal bone.
12. Second metacarpal bone (inner splint bone).

FIG. 4.—TARSAL OR HOCK JOINT SEEN FROM THE INNER SIDE.

1. Tibia.
2. Fibular tarsal bone.
3. Long portion of medial (internal) collateral ligament.
4. Third metatarsal bone (cannon bone).

FIG. 5.—TARSAL JOINTS SEEN FROM THE OUTER SIDE.

1. Fibular tarsal bone.
2. Tibia.
3. Short portion of lateral (external) collateral ligament.
4. Long portion of lateral (external) collateral ligament.
5. Third metatarsal bone.

FIG. 6.—CARPAL OR "KNEE" JOINT SEEN FROM THE OUTER SIDE.

1 and 2. Radius.
3. Attachment of lateral (external) collateral ligament cut across.
4. Accessorio-radial ligament.
5. Deep fibres of lateral (external) collateral ligament connecting the radius to ulnar carpal bone.
6. Ulnar carpal bone.

7. Accessory carpal bone.
8. Portion of inferior ligament of accessory carpal bone inserted into the fourth carpal bone.
9. Band connecting ulnar carpal bone with fourth carpal bone.
10. Third metacarpal bone (cannon bone).

FIG. 7.—SHOULDER-JOINT SEEN FROM THE INNER SIDE.

1. Scapula.
2. Capsularis muscle.
3. Joint capsule.
4. Humerus.

FIG. 8.—THE UPPER EXTREMITY OF THE RIGHT TIBIA WITH SEMILUNAR CARTILAGES ATTACHED, SEEN FROM ABOVE.

1. Attachment of anterior cornu of medial semilunar cartilage (Meniscus medialis) to tibia.
2. Posterior cruciate ligament.
3. Attachment of anterior cornu of lateral semilunar cartilage (Meniscus lateralis) to tibia.
4. Lateral semilunar cartilage (Meniscus lateralis).
5. Anterior cruciate ligament.
6. Medial semilunar cartilage (Meniscus medialis).

FIG. 9.—FEMORO-TIBIAL ("STIFLE") JOINT SEEN FROM BEHIND.

1. Femur.
2. Upper branch of posterior cornu of lateral semilunar cartilage, which is attached to femur.
3. Lateral semilunar cartilage (Meniscus lateralis).
4. Lateral collateral ligament.
5. Lower branch of posterior cornu of lateral semilunar cartilage, which is attached to tibia.
6. Fibula.
7. Interosseous membrane of leg between tibia and fibula.
8. Medial semilunar cartilage (Meniscus medialis).
9. Posterior cruciate ligament.
10. Tibia.

FIG. 10.—HOOF SEEN FROM BELOW.

1. Heel.
2. Bar.
3. Line of soft horn between wall and sole.
4. Frog.
5. Sole.
6. Lower or ground border of wall.

FIG. 11.—SENSITIVE FOOT OR HOOF MATRIX SEEN FROM BELOW.

1. Laminal matrix (sensitive laminæ).
2. Plantar or digital cushion or torus.
3. Sensitive sole or solar matrix.

FIG. 12.—RIGHT HALF OF WALL OF HOOF REMOVED TO SHOW LAMINAL MATRIX.

1. Complementary cartilage of third phalanx.
2. Coronary matrix (coronary cushion).
3. Laminal matrix (sensitive laminæ).
4. Cut edge of wall of hoof.
5. Third phalanx.
6. Cut edge of sole of hoof.

FIG. 13.—HOOF MATRIX SEEN FROM SIDE.

1. Matrix with which is connected the varnish-like (when dry) outer layer of the wall of the hoof.
2. Coronary cushion or coronary matrix.
3. Sensitive laminæ or laminal matrix.

FIG. 14.—METACARPO-PHALANGEAL JOINT (FETLOCK-JOINT) AND DIGIT SEEN FROM THE SIDE, SHOWING LIGAMENTS.

1. "Suspensory or superior sesamoidean ligament." A modified interosseous muscle.
2. Third metacarpal bone.
3. Sesamoid bone.
4. Superficial division of the collateral ligament of fetlock-joint.
5. Straight sesamoidean ligament.
6. First phalanx.
7. Collateral ligament of pastern-joint.
8. Second phalanx.
9. Collateral sesamoidean ligament.

FIG. 15.—METACARPO-PHALANGEAL JOINT (FETLOCK-JOINT) AND DIGIT SEEN FROM BEHIND, SHOWING LIGAMENTS.

1. Suspensory ligament or superior sesamoidean ligament.
2. Sesamoid bones.
3. Deep or cruciate sesamoidean ligament.
4. Lateral portion of oblique sesamoidean ligament.
5. Central band of volar or posterior ligament of pastern-joint.
6. Lateral band of volar or posterior ligament of pastern-joint.
7. Collateral sesamoidean ligament.
8. Phalango-sesamoidean ligament.

FIG. 16.—FETLOCK-JOINT AND DIGIT SEEN FROM BEHIND, SHOWING LIGAMENTS.

1. Suspensory ligament or superior sesamoidean ligament.
2. Groove formed by sesamoid bones for flexor tendons.
3. Lateral portion of oblique sesamoidean ligament.
4. Superficial or straight sesamoidean ligament.
5. Central band of volar or posterior ligament of pastern-joint.
6. Collateral sesamoidean ligament.
7. Phalango-sesamoidean ligament.

FIG. 17.—FETLOCK AND DIGIT SEEN FROM BEHIND, SHOWING LIGAMENTS AND TENDONS.

1. Tendon of the superficial flexor of the digit.
2. Fascial tendon sheath of fetlock.
3. Tendon of deep flexor of the digit.

FIG. 18.—MEDIAL SECTION OF FETLOCK AND DIGIT.

1. Tendon of deep flexor of the digit.
2. Tendon of common extensor of the digit.
3. Tendon of superficial flexor of the digit.
4. Third metacarpal (cannon) bone.
5. Sesamoid bone.
6. "Fetlock-joint" cavity.
7. First phalanx.
8. Sesamoidean tendon sheath.
9. Superficial or straight sesamoidean ligament.
10. "Pastern-joint" cavity.

11. Same as 8.
12. Second phalanx.
13. Same as 1.
14. "Coffin-joint" cavity.
15. Third phalanx.
16. Cut edge of wall of hoof.
17. Laminal matrix.
18. Cut edge of sole of hoof.
19. Sesamoid bone of third phalanx.
20. Sesamoidean bursa or sheath.
21. Cut surface of plantar or digital cushion or torus.

FIG. 19.—LOWER PORTION OF FORE-LIMB SEEN FROM THE FRONT, SHOWING TENDONS OF EXTENSOR MUSCLES.

1. Tendon of radial extensor of the carpus.
2. Tendon of abductor pollicis muscle.
3. Tendon of common extensor of the digit.
4. Tendon of lateral extensor of the digit.
5. Same as 3.
6. Branch of superior sesamoidean or suspensory ligament which joins the tendon of the common extensor of the digit.

PLATE I.A.

REGIONS ON THE EXTERIOR OF THE HORSE.

1. Nose.
2. "Forelock."
3. "Poll."
4. "Crest" and mane.
5. Neck.
6. "Withers."
7. Loins.
8. "Point of the hip" formed by the projecting angle of the ilium.
9. Hip-joint. (The actual joint is a little lower than the point of the arrow.)
10. Root of tail.
11. Cheek.
12. "Jaw."
13. Parotid region.
14. "Throat."
15. Groove which indicates the position of the jugular vein.
16. Shoulder.
17. Shoulder-joint ("point of shoulder").
18. Arm.
19. Breast.
20. Lower lip.
21. Forearm.
22. Carpus ("knee").
23. Metacarpus ("cannon bone").
24. First phalanx ("pastern").
25. Hoof ("foot").
26. "Fetlock."
27. Projection corresponding to the free end of the olecranon of the ulna ("elbow").
28. "Ribs."
29. Flank.
30. Position of the patella ("stifle").
31. Thigh ("quarter").
32. Leg ("lower thigh").
33. Corresponding to the free end of the calcaneus ("point of hock").
34. Tarsus ("hock").
35. Metatarsus ("cannon bone").
36. First phalanx ("pastern").

PLATE I.

FIG. 1.—THE SUPERFICIAL MUSCLES.

1. Orbicular muscle of the eyelids (M. orbicularis oculi).
2. Levator of the nose and lip (M. levator naso-labialis).
3. Proper levator of the upper lip (M. levator labii superioris proprius).
4. Zygomatic muscle (M. zygomaticus).
5. Buccinator muscle (M. buccinatorius).
6. Masseter muscle (M. masseter).
7. Sterno-cephalic muscle (M. sterno-cephalicus), also known as the sterno-mandibular muscle, from its attachments.
8. Brachio-cephalic muscle (M. brachio-cephalicus).
9. The cervical portion of the ventral serrate muscle (M. serratus ventralis).
10. Deltoid muscle (M. deltoideus).
11. Clavicular part of the superficial pectoral muscle (M. pectoralis superficialis). The clavicle being absent in the horse, this part of the superficial pectoral has shifted its attachment to the nearest part of the sternum.
12. Brachialis muscle (M. brachialis).
13. Radial extensor of the carpus (M. extensor carpi radialis).
14. Common extensor of the digit (M. extensor digitorum communis). The Latin version of the name indicates that, though the modern horse is possessed of only one digit in each limb, the ancestors of the horse had more than one digit. The Latin name also serves as a reminder that the muscle is the homologue of that which extends the several digits of animals like the dog and cat.
15. Extensor of the fifth digit (M. extensor digiti quinti), or lateral extensor of the digit. The first name is given to this muscle on the assumption that it is the homologue of the extensor of the little finger of man.
16. Ulnar extensor of the carpus (M. extensor carpi ulnaris). There can be little doubt that this muscle is a *flexor* of the carpus, the change in function being associated with the morphological modifications which have taken place in the limb of the modern horse.
17. Radial flexor of the carpus (M. flexor carpi radialis).
18. Ulnar flexor of the carpus (M. flexor carpi ulnaris).
19. Triceps muscle of the arm (M. triceps brachii). The arrow points to the lateral head of this muscle. The long head is immediately behind the lateral; while the medial head (the smallest of the three) is on the other side of the limb, and, therefore, not shown in the figure.
20. That part of the deep pectoral muscle (M. pectoralis profundus) which is inserted to the humerus.
21. The thoracic part of the ventral serrate muscle (M. serratus ventralis).

22. Splenius (M. splenius).
23 and 24. Cervical and thoracic parts of the trapezius (M. trapezius).
25. Latissimus dorsi muscle (M. latissimus dorsi).
26. Superficial gluteal (M. glutæus superficialis).
27. Biceps muscle of the thigh (M. biceps femoris).
28. Semitendinous muscle (M. semitendinosus).
29. Tensor of the broad fascia of the thigh (M. tensor fasciæ latæ).
30. Part of the superficial gluteal.
31. Long extensor of the digit (M. extensor digitorum longus). The Latin form of the name indicates that the ancestors of the horse had more than one digit.
32. Anterior tibial (M. tibialis anterior).
33. Long flexor of the digit (M. flexor digitorum longus).
34. Posterior tibial (M. tibialis posterior).
35. Long flexor of the hallux (M. flexor hallucis longus). This name is given to the muscle on the assumption that it is the homologue of the flexor of the hallux (great toe) of man.
    The long flexor of the digit, posterior tibial, and the flexor of the hallux, form three parts of the deep flexor of the digit.
36. Long extensor of the digit (M. extensor digitorum longus).
37. Peroneal muscle (M. peronæus).
38. The lateral head of the gastrocnemius (M. gastrocnemius).
39. Soleus muscle (M. soleus).
40. Abductor pollicis muscle (M. abductor pollicis). This is another example of a muscle which has shifted its primary attachment. The pollex, or thumb, of the horse having disappeared, the muscle is now inserted to the second (inner) metacarpal bone.

Fig. 2.—The Deeper Muscles of the Neck and Shoulder.

1. Semispinal muscle of the head (M. semispinalis capitis).
2. Rhomboid muscle (M. rhomboideus).
3. Cervical part of the ventral serrate muscle (M. serratus ventralis).
4. Sterno-cephalic, or sterno-mandibular, muscle (M. sterno-cephalicus).
5. Omo-hyoid muscle (M. omo-hyoideus).
6. Prescapular part of the deep pectoral (M. pectoralis profundus).
7. Supraspinous muscle (M. supraspinatus).
8. Infraspinous muscle (M. infraspinatus).
9. Teres minor (M. teres minor).
10. Brachialis muscle (M. brachialis).
11. Triceps muscle of the arm (M. triceps brachii).
12. The thoracic part of the ventral serrate muscle (M. serratus ventralis).

Fig. 3.—Transverse Section of the Limb about the Middle of the Forearm.

1. Radial extensor of the carpus (M. extensor carpi radialis).
2. Collateral radial artery (A. collateralis radialis) and its companion vein.
3. Common extensor of the digit (M. extensor digitorum communis).
4. Abductor pollicis muscle (M. abductor pollicis).
5. Extensor of the fifth digit (M. extensor digiti quinti), or lateral extensor of the digit.
6. Ulnar extensor of the carpus (M. extensor carpi ulnaris).
7. Ulnar head of the deep flexor of the digit.
8. Ulnar collateral artery (A. collateralis ulnaris) and its companion vein.
9. Superficial flexor of the digit (M. flexor digitorum sublimis).
10. Ulnar flexor of the carpus (M. flexor carpi ulnaris).
11. Deep flexor of the digit (M. flexor digitorum profundus).
12. Radial flexor of the carpus (M. flexor carpi radialis).
13. Median artery, vein and nerve (A. mediana, V. mediana, N. medianus).
14. Cephalic vein (V. cephalica).
15. Radius.

Fig. 4.—Transverse Section of the Limb about the Middle of the Thigh.

1. Rectus femoris muscle (M. rectus femoris).
2. Medial vastus muscle (M. vastus medialis).
3. Sartorius muscle (M. sartorius).
4. Saphenous vein (V. saphena).
5. Saphenous nerve (N. saphenus).
6. Femoral artery (A. femoralis) and vein.
7. Gracilis muscle (M. gracilis).
8. Adductor muscle (M. adductor).
9. Semimembranous muscle (M. semimembranosus).
10. Semitendinous muscle (M. semitendinosus).
11, 12, and 15. The three parts of the biceps muscle of the thigh (M. biceps femoris).
13. Common peroneal and tibial nerves (N. peronæus communis, N. tibialis).
14. Vein accompanying these nerves.
16. Femur.
17. Intermediate vastus muscle (M. vastus intermedius).
18. Lateral vastus muscle (M. vastus lateralis).

Fig. 5.—Muscles lying in Front of the Tibia.

1 and 4. The two ends of the fleshy belly of the long extensor of the digit (M. extensor digitorum longus).
    The greater part of the belly has been removed.
2. Peronæus tertius muscle (M. peronæus tertius). It is open to question whether this muscle is the true homologue of the third peroneal muscle of man.
    Though this is undoubtedly a modified muscle, it has lost all its muscular structure, and is now a flattened tendinous band which acts as a mechanical stay for the tarsus.
3. Anterior tibial muscle (M. tibialis anterior).

Fig. 6.—Muscles lying Behind the Tibia.

1. Gastrocnemius (M. gastrocnemius).
2. Flexor hallucis longus (M. flexor hallucis longus).
3. Long flexor of the digit (M. flexor digitorum longus).
4. Tendon of the plantaris muscle (M. plantaris). Though the plantaris muscle is deep to the gastrocnemius in the upper part of the tibial region, in the distal third of the leg the plantaris tendon twists round that of the gastrocnemius, and thus becomes superficial as the

tarsus is approached. The two tendons here form what is known as the "tendon of Achilles."

Throughout the whole of its length the plantaris muscle is composed mainly of tendinous tissue. It is, therefore, capable of acting, along with the peronæus tertius, as a mechanical stay for the tarsus.

PLATE II.

Fig. 1.—The Muscles of the Ventral (Lower) Aspect of the Body.

1. Mylo-hyoid muscle (M. mylo-hyoideus).
2. Masseter (M. masseter).
3. Group of lymph glands lying in the space between the two halves of the mandible.
4. Sterno-hyoid muscle (M. sterno-hyoideus).
5. Sterno-cephalic muscle (M. sterno-cephalicus).
6. Brachio-cephalic muscle (M. brachio-cephalicus).
7. Clavicular part of the superficial pectoral muscle (M. pectoralis superficialis). (See note 11, Plate I.)
8. The end of the sternum, to which a slip of the cutaneous muscle (the muscle concerned in shaking the skin) is attached.
9. Sternal part of the superficial pectoral muscle.
10. Deep pectoral muscle (M. pectoralis profundus). The deep pectoral is clearly divided into two parts. That shown in the figure is the humeral portion. The prescapular part is completely hidden by the superficial pectoral muscle.
11. External oblique abdominal muscle (M. obliquus externus abdominis).
12. Sartorius muscle (M. sartorius).
13. Gracilis muscle (M. gracilis).
14. Semimembranous muscle (M. semimembranosus).
15. Adductor muscle (M. adductor).
16. Pectineus muscle (M. pectineus).
17. Medial vastus muscle (M. vastus medialis).

Fig. 2.—Transverse Section of the Abdomen (made just in Front of the Kidneys), looking towards the Entrance to the Pelvis.

1. Left kidney.
2. Abdominal aorta.
3. Right adrenal body.
4. Right kidney.
5. Caudal (posterior) vena cava close to its commencement.
6. Rectum.
7. Urinary bladder.

Fig. 3.—Transverse Section of the Abdomen (made just Behind the Kidneys), looking towards the Diaphragm.

(*The figure shows the relative position of the organs in contact with the diaphragm*).

1. Right kidney.
2. Duodenum.
3. Liver.
4. Abdominal aorta.
5. Caudal (posterior) vena cava.
6. Left kidney.
7. Spleen.
8. Portal vein. Its relation to the pancreas is more clearly shown in Fig. 7, 3.
9. Pancreas.
10. Stomach.

Fig. 4.—Longitudinal Section of the Stomach and Part of the Duodenum.

1. That part of the mucous lining of the stomach which is continuous with and similar to the lining of the œsophagus. One of the characteristic features of the stomach of the horse is the continuation of the œsophageal mucous membrane into the left half of the viscus.
2. The irregular but sudden line at which the œsophageal mucous membrane ceases.
3. The soft, highly vascular mucous membrane containing the microscopic glands which produce the gastric secretion.
4. Œsophagus.
5. Duodenum. The arrow points to the first part of the tube, which is somewhat wider than the rest.
6. The bile duct which opens into the duodenum in common with the pancreatic duct.
7. The pylorus, or exit from the stomach. The wall of the stomach is considerably thicker here from the presence of a ring of muscular tissue which forms a sphincter.

Fig. 5.—The Stomach from its Posterior Aspect.

1. Over this area the smooth, moist, and glistening peritoneal investment (serous tunic) of the stomach has been removed to show the underlying muscular tunic.
2. Pylorus.
3. Duodenum.

Fig. 6.—The Disposition of the Large Intestine as seen after Removal of the Ventral (Inferior) Abdominal Wall.

1. Left ventral colon.
2. A coil of small intestine. Other portions of the small intestine are shown at the right lower part of the figure. These are not always visible when the abdomen is first opened.
3. Dorsal diaphragmatic flexure.
4. Ventral diaphragmatic flexure.
5. Right ventral colon.
6. Cæcum.

The very capacious colon of the horse is folded twice on itself. Thus four parts of the tube, joined by three flexures, are distinguishable. Beginning where the colon leaves the cæcum, the parts and flexures are as follows:

1. Right ventral colon.
   Ventral diaphragmatic flexure.
2. Left ventral colon.
   Pelvic flexure.
3. Left dorsal colon.
   Dorsal diaphragmatic flexure.
4. Right dorsal colon.

DESCRIPTION OF PLATES

FIG. 7.—THE PANCREAS AND SOME OF THE RELATED STRUCTURES.

1. The tail, or left extremity, of the pancreas.
2. The caudal (posterior) vena cava.
3. The portal vein as it is piercing the pancreas.
4. The head, or right extremity, of the pancreas closely associated with—
5. The duodenum, into which the pancreatic duct opens in common with the bile duct.

PLATE B.

FIG. 1.—SAGITTAL SECTION OF HEAD.

1. Cut edge of hard palate.
2. Nasal septum.
3. Cerebral hemisphere of brain.
4. Pons Varolii.
5. Cerebellum.
6. Medulla oblongata.
7. Larynx.
8. Body of thyroid cartilage of larynx.
9. Pharynx.
10. Soft palate.
11. Body of hyoid bone.
12. Genio-glossus muscle (tongue).
13. Genio-hyoideus muscle.
14. Mentalis muscle.

FIG. 2.—SAGITTAL SECTION OF SKULL, SHOWING NASAL CAVITY.

1. Superior turbinated bone.
2. Labyrinth of ethmoid bone.
3. Cut edge of hard palate.
4. Cut edge of bone of hard palate.
5. Inferior turbinated bone.

FIG. 3.—PINNA AND AURICULAR MUSCLES.

1. Interscutularis muscle.
2. Scuto-auricularis superficialis inferior muscle.
3. Fronto-scutularis muscle (pars temporalis).
4. Zygomatico-auricularis muscle.
5. Parotid gland.
6. Inferior auricular (parotido-auricularis) muscle.

FIG. 4.—ANTERIOR PORTION OF SKULL SEEN FROM ABOVE.

1. Nasal bone.
2. Anterior naris (opening to nostril).
3. Nasal process of incisive (premaxilla) bone.
4. Lamina of comma-shaped or alar cartilage of nostril.
5. Cornu of same.

FIG. 5.—EYEBALL *IN SITU* AFTER REMOVAL OF EYELIDS.

1. Third eyelid.
2. Lens *in situ* seen through an artificial opening in iris.
3. Sclera (white of eye).

FIG. 6.—LIVER, SHOWING VISCERAL OR POSTERIOR SURFACE.

1. Œsophageal notch.
2. Hepatic artery.
3. Portal vein.
4. Caudal (posterior) vena cava.
5. Renal impression for right kidney.
6. Caudate process.
7. Right lateral lobe.
8. Duodenal impression.
9. Bile or hepatic duct.
10. Central lobe.
11. Left lateral lobe.

FIG. 7A.—COSTAL OR LATERAL SURFACE OF RIGHT LUNG, SHOWING IMPRESSIONS LEFT BY RIBS.

FIG. 7B.—MEDIAL OR MEDIASTINAL SURFACE OF LEFT LUNG.

1. Triangular area of lung not covered by pleura.
2. Groove for aorta.
3. Root and hilus of lung.
4. Impression for accommodation of heart.

FIG. 8.—KIDNEYS, ADRENAL BODIES, AND BLOODVESSELS SEEN FROM ABOVE.

1. Left kidney.
2. Left adrenal body.
3. Caudal (posterior) vena cava.
4. Right adrenal body.
5. Right kidney.
6. Left ureter.
7. Aorta.
8. Right ureter.
9. Right renal artery.

FIG. 9.—POSTERIOR PART OF URINARY BLADDER AND FIRST PART OF URETHRA SLIT IN MIDDLE LINE BELOW AND LAID OPEN.

1. Urinary bladder.
2. Opening of ureter.
3. Colliculus seminalis.
4. Cut edge of hip bone.
5. Opening of deferent duct (ejaculatory duct).
6. Orifice of uterus masculinus.
7. Openings of ducts of bulbo-urethral (Cowper's) glands.

FIG. 10.—INTERNAL GENITAL ORGANS OF STALLION SEEN FROM ABOVE.

1. Urinary bladder.
2. Right deferent duct.
3. Left lateral ligament of bladder.
4. Left vesicula seminalis.
5. Uterus masculinus.
6. Prostate.
7. Left bulbo-urethral (Cowper's) gland.

FIG. 11.—PENIS SEEN FROM THE SIDE.

1. Ischio-cavernosus muscle.
2. Anterior dorsal artery of penis from external pudendal artery.
3. Bulbo-cavernosus muscle.
4. Penis.
5. Glans penis.

DESCRIPTION OF PLATES

Fig. 12.—Cross-Section of Penis.

1. Septum penis.
2. Tunica albuginea.
3. Sponge-like erectile tissue.
4. Urethra.
5. Bulbo-cavernosus muscle.
6. Retractor penis muscle.
7. Erectile tissue surrounding urethra.

PLATE C.

Fig. 1.—Epistropheus (Axis) seen from the Side.

1. Spinous process.
2. Process at the cranial extremity of body around which the atlas rotates (dens, odontoid process).
3. Intervertebral foramen through which the second cervical nerve issues from the vertebral canal.
4. Foramen transversarium.
5. Transverse process.
6. Body or centrum.
7. Caudal (posterior) articular process.

Fig. 2a.—One Half of Fifth Cervical Vertebræ.
Fig. 2b.—Sixth Cervical Vertebræ.

1. Spinous process.
2. Articular process.
3. Upper portion of transverse process.
4. Lower portion of transverse process.

Fig. 3a.—A Thoracic Vertebra seen from Behind.

1. Spinous process.
2. Vertebral foramen.
3. Body or centrum.
4. Transverse process.
5. Costal facet for head of rib.

Fig. 3b.—Bones of the Digit seen from the Front.

1. First phalanx (os suffraginis).
2. Second phalanx (os coronæ).
3. Sesamoid bone of third phalanx (navicular bone).
4. Articular surface of third phalanx.
5. Anterior surface of third phalanx.

Fig. 4.—First Thoracic Vertebra.

1. Spinous process.
2. Articular process.
3. Transverse process.
4. Costal facet for head of first rib.

Fig. 5.—A Lumbar Vertebra.

1. Spinous process.
2. Mammillary process.
3. Articular process.
4. Vertebral foramen.
5. Transverse process.
6. Body.

Fig. 6.—Left Scapula seen from Outer Aspect.

1. Scapular cartilage.
2. Spine.
3. Coracoid process.
4. Glenoid cavity for head of humerus.

Fig. 7.—Bones of the Digit and Distal Portion of the Metatarsus.

1. Third metatarsal bone.
2. Sesamoid bone.
3. First phalanx.
4. Second phalanx.
5. Sesamoid bone of the third phalanx.
6. Third phalanx.

Fig. 8.—Sagittal Section of Proximal Portions of Radius and Ulna.

1. Ulna.
2. Radius.

Fig. 9.—Left Radius and Ulna seen from Outer Aspect.

1. Semilunar notch of ulna for articulation with humerus.
2. Ulna.
3. Interosseous space between radius and ulna.
4. Radius.
5. Distal tuberosity of radius, which is really the distal end of the ulna.

Fig. 10.—Left Carpus seen from the Outer Aspect.

1. Radius.
2. Intermediate carpal bone.
3. Third carpal bone.
4. Fourth carpal bone.
5. Third metacarpal bone.
6. Accessory carpal bone.
7. Ulnar carpal bone.
8. Fourth metacarpal bone (outer splint bone).

Fig. 11a.—Right Tarsus seen from the Front.

1. Fibular tarsal bone.
2. Tibial tarsal bone.
3. Central tarsal bone.
4. Fourth tarsal bone.
5. Third tarsal bone.
6. Fourth metatarsal bone (outer splint bone).
7. Third metatarsal bone.

Fig. 11b.—Right Tarsus seen from Behind.

1. Tibial tarsal bone.
2. Fibular tarsal bone.
3. Central tarsal bone.
4. United first and second tarsal bones (cuneiform parvum).
5. Fourth tarsal bone.
6. Second metatarsal bone (inner splint bone).
7. Third metatarsal bone.
8. Fourth metatarsal bone (outer splint bone).

DESCRIPTION OF PLATES

FIG. 12A.—LEFT HUMERUS SEEN FROM THE OUTER ASPECT.

1. Greater tubercle.
2. Deltoid tuberosity.
3. Pulley-like area for articulation with the radius.
4. Lateral (extensor) epicondyle.
5. Medial (flexor) epicondyle.

FIG. 12B.—LEFT HUMERUS SEEN FROM THE FRONT.

1. Intertubercular groove through which the tendon of the biceps brachii muscle plays.
2. Greater tubercle.
3. Deltoid tuberosity.
4. Pulley-like area for articulation with radius.

FIG. 13.—VIEW OF PROXIMAL EXTREMITY AND POSTERIOR ASPECT OF RIGHT METACARPAL BONES.

1. Third metacarpal bone.
2. Second metacarpal bone (inner splint bone).
3. Fourth metacarpal bone (outer splint bone).
4. Second metacarpal bone.
5. Fourth metacarpal bone.
6. Third metacarpal bone.
7. Area for articulation with sesamoid bone.

FIG. 14.—RIGHT TIBIA: *A* SEEN FROM OUTER SIDE; *B* SEEN FROM BEHIND.

1. Lateral condyle.
2. Tuberosity.
3. Medial condyle.
4. Intercondyloid eminence.
5. Same as 1.
6. Crest.
7. Fibula.
8. Medial malleolus.
9. Lateral malleolus, morphologically the distal end of the fibula.
10. Groove on lateral malleolus for the tendon of the peronæus longus muscle.

FIG. 15A.—RIGHT FEMUR SEEN FROM THE OUTER ASPECT.

1. Great trochanter.
2. Third trochanter.
3. Condyles.
4. Trochlea for articulation with patella.

FIG. 15B.—SAME BONE SEEN FROM BEHIND.

1. Head.
2. Upper extremity.
3. Great trochanter.
4. Small internal trochanter.
5. Third trochanter.
6. Medial condyle.
7. Lateral condyle.

FIG. 16.—VIEW OF PROXIMAL EXTREMITIES AND POSTERIOR ASPECT OF METATARSAL BONES.

1, 2, 3. Proximal extremities of third metatarsal, second metatarsal, and fourth metatarsal bones respectively.
4. Second metatarsal bone (inner splint bone).
5. Fourth metatarsal bone (outer splint bone).
6. Third metatarsal bone.
7. Area for articulation with sesamoid bone.

PLATE III.A.

ILLUSTRATES THE RELATIVE POSITION OF THE MORE IMPORTANT THORACIC AND ABDOMINAL ORGANS.

1. Left lung.
2. The line marks the position of the diaphragm in the median plane of the body.
3. Liver.
4. Stomach.
5. Spleen.
6. Left kidney.
7. Some coils of the small colon.
8. Urinary bladder.
9. Rectum.
10. Heart.
11. The left dorsal colon close to the dorsal diaphragmatic flexure.
12. The left ventral colon close to the ventral diaphragmatic flexure.
13. The dotted line indicates the position of the costal arch formed by the ribs.
14. Coils of small intestine.
15. Testis.
16. Deferent duct leading from the testis to the urethra.
17. Seminal vesicle.
18. Prostate.
19. Bulbo-urethral gland.

PLATE III.

FIG. 1.—THE SKELETON.

1. The *skull.*

2 to 8. The *vertebral column.* The vertebræ are divided into five groups: cervical, thoracic, lumbar, sacral, and coccygeal. The *cervical vertebræ,* seven in number, form the skeleton of the neck, and, like the vertebræ of other regions of the column, are named numerically. The first and second, however, have features which clearly distinguish them from all the rest, and are known by special names. The first is the *atlas* (2); the second, the *epistropheus* (3).

4. Third, fourth, fifth, sixth, and seventh cervical vertebræ.
5. The *thoracic vertebræ,* eighteen in number, to which the ribs are attached. These vertebræ help to form the skeleton of the thorax, or chest.
6. The six *lumbar vertebræ* which form the skeleton of the loins.
7. The *sacrum,* composed of five vertebræ fused together, so as to provide a firm foundation for the limb.
8. *Coccygeal vertebræ* (about eighteen or twenty in number), forming the bony skeleton of the tail.
9. *Scapula.*
10. *Humerus.*
11. *Ulna.*
12. The bony segment of a rib.

13. The cartilaginous segment of a rib.
The cartilages of the first eight ribs on each side of the body reach the sternum: the rest do not. The ribs, therefore, are divided into *sternal* and *asternal*.
14. *Radius*.
15. *Carpus*, composed of seven or eight bones arranged in two rows.
16. *Metacarpus*, in which there are three bones. The middle bone of the three is large and long; the others are rudimentary.
17, 18, and 19. The first, second, and third *phalanges* of the single digit possessed by the modern horse.
20. *Ilium*.
21. *Ischium*.
22. *Femur*.
23. *Patella*.
24. *Fibula*.
25. *Tibia*.
26. *Metatarsus*.
27, 28, and 29. First, second, and third *phalanges*.
Between the tibia and the metatarsus is a collection of six bones forming the *tarsus*.

FIG. 2.—THE SKULL WITH THE MANDIBLE SEEN FROM BEHIND.

1. Occipital bone.
2. Foramen magnum (of the occipital bone), by which the cavity of the cranium is placed in communication with the vertebral canal, thus permitting continuity of the brain and spinal cord.
3. The posterior aperture of the nasal cavity.
4. Condyle of the occipital bone.
5. The mandibular joint, between the temporal bone and the mandible.
6. Jugular process of the occipital bone.
7. Sphenoid bone.
8. Vomer, the bone which assists in the separation of the two nasal cavities.
9. Mandible.
10. Palatine bone. The arrow points to the posterior edge of the bony expanse which separates the nasal cavities from the mouth.

FIG. 3.—TRANSVERSE SECTION OF THE NASAL CAVITY IMMEDIATELY IN FRONT OF THE CRIBRIFORM PLATE OF THE ETHMOID BONE.

1. Section of the frontal bone.
2. The interior of the air-sinus (concho-frontal sinus) in the frontal bone. This sinus communicates with the maxillary sinus (Fig. 5, 4), which in its turn communicates with the nasal cavity. In this way air reaches the interior of the frontal bone.
3. Section through the base of the labyrinth of the ethmoid. The labyrinth projects into the cavity of the nose from the cribriform plate of the ethmoid, which forms a transverse partition between the cavity of the cranium and that of the nose. Through the cribriform plate (so named from the presence in it of numerous foramina) pass the nerves of smell.
4. Perpendicular plate of the ethmoid in section. This plate assists in the formation of the partition between the two nasal cavities.
5. Communication between the nasal cavity and the air-sinus in the sphenoid bone.
6. Sphenoid bone.

FIG. 4.—TRANSVERSE SECTION ACROSS THE NOSE ON A LEVEL WITH THE THIRD UPPER CHEEK-TOOTH.

Two turbinated bones (or conchæ), consisting of very delicate sheets of bony tissue rolled upon themselves, protrude into each nasal cavity from its lateral wall. As a consequence of the presence of the turbinated bones the cavity of the nose is converted into long and comparatively narrow passages, or meatuses. The turbinated bones are covered by an exceedingly vascular mucous membrane over which the air is forced to pass. In this manner the air, as it traverses the passages of the nose, is warmed, and to a certain extent cleared of dust and other particles.

1. Upper turbinated bone, or concha.
2. Cartilaginous septum between the two nasal cavities.
3. Lower turbinated bone.
4. Upper meatus of the nose.
5. Middle meatus.
6. Lower meatus.

FIG. 5.—TRANSVERSE SECTION ACROSS THE NOSE ON A LEVEL WITH THE FIFTH UPPER CHEEK-TOOTH.

1. Upper turbinated bone.
2. Lower turbinated bone.
3. The air-sinus of the frontal bone continued into the turbinated bone.
4. Maxillary air-sinus. It will be noticed that this sinus is continued into the lower turbinated bone over a plate of bone (shown, in the section, with the infra-orbital canal in its free border).
5. Cartilaginous septum of the nose.

FIG. 6.—THE RIGHT AND LEFT HIP-BONES.

1. Coxal tuber of the ilium, which forms the projection on the surface of the body frequently called "the angle of the haunch."
2. Gluteal surface of the ilium.
3. Sacral tuber of the ilium ("the angle of the croup").
4. Greater sciatic notch.
5. Pubis.
6. Sciatic spine.
7. Obturator foramen.
8. Lesser sciatic notch.
9. Sciatic tuber of the ischium.
10. The line of union, or symphysis, of the two hip-bones.
11. Ischium.

FIG. 7.—THE LEFT HIP-BONE SEEN FROM THE SIDE.

1. Sacral tuber of the ilium.
2. Gluteal surface of the ilium.

3. Coxal tuber of the ilium.
4. Sciatic spine.
5. Ischium.
6. Sciatic tuber of the ischium.

Fig. 8.—The Bones bounding the Entrance to the Chest.

The thoracic entrance is in the form of a narrow isosceles triangle with the base above, and is bounded by the first thoracic vertebra, the first pair of ribs, and the sternum.

1. Spinous process of the first thoracic vertebra.
2. Articular process.
3. Vertebral foramen in which the spinal cord is lodged.
4. Body of the vertebra.
5. Tubercle of the rib.
6. Head and neck of the rib.
7. Sternum.

PLATE IV.

Fig. 1.—Diagram of the Principal Arteries and Veins.

1. Superior labial artery (A. labialis superior).
2. Lateral nasal artery (A. lateralis nasi).
3. Dorsal nasal artery (A. dorsalis nasi).
4. Angular artery of the eye (A. angularis oculi).
5. Reflex vein (V. reflexa) which connects the veins of the face with the venous sinuses in the cranium.
6. Internal maxillary artery (A. maxillaris interna).
7. Posterior auricular vein (V. auricularis posterior).
8. External carotid artery (A. carotis externa).
9. Occipital artery (A. occipitalis).
10. Common carotid artery (A. carotis communis).
11. Inferior labial artery (A. labialis inferior).
12. Facial artery (A. facialis).
13. Buccinator vein (V. buccinatoria).
14. External maxillary artery (A. maxillaris externa).
15. External maxillary vein (V. maxillaris externa).
16. Jugular vein (V. jugularis).
17. Vertebral artery (A. vertebralis).
18. Deep cervical artery (A. cervicalis profunda).
19. Transverse artery of the neck (A. transversa colli).
20. Pulmonary artery (A. pulmonalis), which carries *venous* blood to the lung.
21. Aorta. The arrow points to the thoracic part of this vessel.
22. Cœliac artery (A. cœliaca).
23. Cranial (anterior) mesenteric artery (A. mesenterica cranialis).
24. Renal artery (A. renalis).
25. Caudal mesenteric artery (A. mesenterica caudalis).
26. Internal spermatic artery (A. spermatica interna).
27. Deep circumflex iliac artery (A. circumflexa ilium profunda).
28. External spermatic artery (A. spermatica externa).
29. Cranial gluteal artery (A. glutæa cranialis).
30. Lateral sacral artery (A. sacralis lateralis).
31. Omo-cervical trunk (Truncus omo-cervicalis).
32. Internal thoracic artery (A. thoracica interna).
33. Thoraco-acromial artery (A. thoraco-acromialis).
34. Subscapular artery (A. subscapularis).
35. Deep brachial artery (A. profunda brachii).
36. Cephalic vein (V. cephalica).
37. Collateral radial artery (A. collateralis radialis).
38. Collateral ulnar artery (A. collateralis ulnaris).
39. Median artery (A. mediana).
40. Common interosseous artery (A. interossea communis).
41. Medial volar metacarpal artery (A. metacarpea volaris medialis).
42. Lateral volar metacarpal artery (A. metacarpea volaris lateralis).
43. Common digital artery (A. digitalis communis).
44. Volar digital artery (A. digitalis volaris).
45. Right ventricle of the heart.
46. Left coronary artery (A. coronaria sinistra).
47. Left ventricle of the heart.
48. Left atrium (auricle) of the heart.
49. Caudal vena cava (V. cava caudalis).
50. Minute vessels (sinusoids) within the liver formed by—
51. Portal vein (V. portæ).
52. External iliac artery (A. iliaca externa).
53. Anterior femoral artery (A. femoris anterior).
54. Saphenous artery (A. saphena).
55. Popliteal artery (A. poplitea).
56. Anterior tibial artery (A. tibialis anterior).
57. Dorsalis pedis artery (A. dorsalis pedis).
58. Lateral dorsal metatarsal artery (A. metatarsea dorsalis lateralis).
59. Common digital artery (A. digitalis communis).
60. Volar digital artery (A. digitalis volaris).
61. Caudal gluteal artery (A. glutæa caudalis).
62. Internal pudendal artery (A. pudenda interna).
63. Obturator artery (A. obturatoria).
64. Pudendo-epigastric trunk (Truncus pudendo-epigastricus).
65. Femoral artery (A. femoralis).
66. Posterior femoral artery (A. femoris posterior).
67. Posterior tibial artery (A. tibialis posterior).
68. Recurrent tibial artery (A. tibialis recurrens).
69. Medial tarsal artery (A. tarsea medialis).

Fig. 2.—Diagram of the Bloodvessels Behind the Carpus Metacarpus, and Digit.

1. Collateral ulnar artery.
2. Median artery close to its termination.

3 and 6. Lateral volar metacarpal artery.

4. Medial volar metacarpal artery.
5. Lateral dorsal metacarpal artery.
7. Common digital artery just before it divides into
8. Volar digital arteries.

Fig. 3.—The Chief Bloodvessels of the Digit as seen from Below and Behind.

1. The volar digital artery and vein.
2. The branch of the digital artery which enters the canal within the third phalanx.

Fig. 4.—The Chief Bloodvessels of the Digit as seen from the Side.

The references are the same as in Fig. 3.

DESCRIPTION OF PLATES

FIG. 5.—DIAGRAM OF THE ARTERIES WHICH SUPPLY BLOOD TO THE STOMACH, LIVER, SPLEEN, AND PANCREAS.

1. Splenic artery (A. lienalis).
2. Cœliac artery (A. cœliaca), the vessel from which all the others are derived either directly or indirectly.
3. Hepatic artery (A. hepatica).
4. Left gastric artery (A. gastrica sinistra).
5. Œsophageal ramus of the left gastric.
6. Right gastric artery (A. gastrica dextra).
7. Gastro-duodenal artery (A. gastro-duodenalis).
8. Pancreatico-duodenal artery (A. pancreatico-duodenalis).
9. Caudal (posterior) branch of the left gastric.
10. Cranial (anterior) branch of the left gastric.
11. Right gastro-epiploic artery (A. gastro-epiploica dextra).
12. Left gastro-epiploic artery (A. gastro-epiploica sinistra).

FIG. 6.—THE CÆCUM AND LARGE COLON, WITH THEIR BLOODVESSELS.

1. Pelvic flexure of the colon.
2. Left ventral colon.
3. Left dorsal colon.
4. Ventral colic artery (A. colica ventralis).
5. Right ventral colon.
6. Dorsal colic artery (A. colica dorsalis).
7. Right dorsal colon.
8. Middle colic artery (A. colica media).
9. Commencement of the small colon.
10. One of the cæcal branches of the ileo-cæcal artery.
11. Cæcum.
12. Ileum with the iliac branch of the ileo-cæcal artery.

For an explanation of the disposition of the large colon, reference should be made to Plate III., Fig. 6.

FIG. 7.—THE KIDNEYS AND URINARY BLADDER, WITH SOME OF THEIR ASSOCIATE STRUCTURES AS SEEN FROM ABOVE.

1. Left kidney.
2. Left adrenal gland.
3. Aorta.
4. Right adrenal gland.
5. Right kidney.
6. Renal artery (A. renalis).
7. Left ureter. The duct of the kidney which carries the urine to the bladder.
8. External iliac artery (A. iliaca externa).
9. Umbilical artery (A. umbilicalis). This vessel in the embryo carries the blood to the placenta. In the adult it is mainly converted into a fibrous cord which occupies the edge of the lateral peritoneal fold of the bladder.
10. Hypogastric artery (A. hypogastrica).
11. Urinary bladder.

PLATE D.

FIG. 1.—VIEW OF SKULL, SHOWING UPPER TEETH.

1. Central, intermediate, and corner incisor teeth.
2. Canine tooth.
3. Premolar teeth.
4. Molar teeth.

FIG. 2.—MANDIBLE, SHOWING LOWER TEETH.

1. Central, intermediate, and corner incisor teeth.
2. Canine tooth.
3. Premolar teeth.
4. Molar teeth.

FIG. 3.—LOWER (MANDIBULAR) INCISOR AND CANINE TEETH WITH ROOTS LAID BARE.

1. Central incisor tooth.
2. Intermediate incisor tooth.
3. Corner incisor tooth.
4. Canine tooth.

FIG. 4.—INCISOR TOOTH SEEN FROM THE FRONT.

FIG. 5.—INCISOR TOOTH SEEN FROM BEHIND.

FIG. 6.—CROSS AND VERTICAL SECTIONS OF MOLAR TOOTH, SHOWING THE STRUCTURE.

1. Dentine. This forms the main bulk of the tooth.
2. Cavity called the infundibulum produced by folding of the enamel.
3. Enamel (here coloured black). This is by far the hardest tissue forming the tooth.
4. Cement, or crusta petrosa, which forms the outer layer of tooth.
5. Enamel.
6. Cement, or crusta petrosa.
7. Cement between enamel folds.
8. Dentine.
9. Pulp cavity.

FIG. 7.—CROSS AND VERTICAL SECTIONS OF INCISOR TOOTH, SHOWING STRUCTURE.

1. Infundibulum, a fossa on the table of the tooth.
2. Cement.
3. Enamel.
4. Dentine.
5. Pulp cavity.

FIG. 8.—INCISOR TOOTH WITH PORTION REMOVED.

1. The infundibulum lined by enamel (coloured black).

FIG. 9.—FIGURES SHOWING THE DIFFERENCES IN FORM OF THE INCISOR AND CANINE TEETH FROM ONE TO EIGHT YEARS OF AGE.

A. One year.
B. Two years.
C. Three years.
D. Four years.
E. Five years.
F. Six years.
G. Seven years.
H. Eight years.

DESCRIPTION OF PLATES

PLATE E.

Fig. 1.—Reproductive and Urinary Organs of the Mare, seen from the Side.

1. The left kidney.
2. The narrow opening from the uterus to the vagina (os uteri, or orificium externum uteri).
3. Rectum.
4. Vagina.
5. Vulva surrounded by a constrictor muscle.
6. Urinary bladder.
7. The left ureter.
8. The cord-like remains of the left umbilical artery.
9. Round ligament of the uterus.
10. The left cornu of the uterus. The point at which the right and left cornua join to form the body of the uterus is shown.
11. The arrow points to the left uterine tube of Fallopius as it crosses the surface of the left ovary.
12. The broad ligament of the uterus.

Fig. 2.—Reproductive Organs of the Mare, seen from Above.

1. The fimbriated extremity of the uterine tube of Fallopius, which receives the ovum when it is extruded from the ovary.
2. The left cornu of the uterus.
3. The body of the uterus close to the point of union of the two cornua.
4. The right cornu slit open.
5. The left ovary.
6. Broad ligament of the uterus.
7. The projecting part of the neck of the uterus circumscribing the narrow opening (os uteri, or orificium externum uteri) from the uterus into the vagina.
8. Vagina cut open.
9. A transverse fold of mucous membrane: the remains of the hymen.
10. External opening of the urethra. The position of the urinary bladder is indicated by a dotted outline.
11. Openings of the ducts of the vestibular glands.
12. Clitoris.

OBSTETRIC PRESENTATIONS.

With the exception of Prs. 1 and 7, which portray normal birth, the figures represent the principal malpresentations and malpositions assumed by the foal at parturition. Dystocia, or difficult birth, may depend on the dam, but the fœtus is generally at fault in the lower animals. The word Position expresses the relation of a certain portion of the fœtus to the maternal pelvic inlet. It is convenient to choose a fixed point on the fœtal body—the withers for the anterior longitudinal presentation, the loins or lumbar region for the posterior longitudinal presentation, and the head or cephalic region for the transverse presentation. In the longitudinal presentations the first part of the compound word refers to the fœtus, the second to the dam. In Pr. 1, for example, the term *dorso-sacral* means that the dorsum or withers of the fœtus is opposed to the sacrum of the dam; the foal is therefore upright, and the fore parts are presented. Similarly, in Pr. 7, the term *lumbo-sacral* indicates that the lumbar region of the foal is opposite to the sacrum of the mother. Clearly the fœtus is coming the wrong way, hind legs first, but the position is again upright. Presentation, on the other hand, is used to designate that portion of the fœtus which first enters the pelvic inlet or passage.

Pr. 1 = Anterior Presentation: Dorso-Sacral Position.—Nose of foal rests on or near the fetlocks; head, neck, and fore limbs are fully extended. This is the most natural position, and the one generally assumed in normal births.

Pr. 2 = Anterior Presentation: Dorso-Pubic Position.—The foal is on its back, its withers corresponding to the pubis of the mother. The heavy head tends to drop below the pubis towards the bottom of the uterus. The soles of the fore feet are directed upwards.

Pr. 3 = Anterior Presentation: Carpal Flexion.—The foal is upright, but the fore limbs are partially retained, flexed at the knee.

Pr. 4 = Anterior Presentation: Complete Retention of One Fore Limb.—The retained limb is bent backwards under the body of the foal.

Pr. 5 = Anterior Presentation: Lateral Deviation of Head.—Both fore limbs in the passage, the head turned back on the side of the chest, often beyond reach. The fore foot on the same side as the head is less advanced, indicating the side on which the head lies.

Pr. 6 = Dog Sitting (Anterior) Presentation.—Foal doubled up, hind limbs forward under body; five extremities in the passage or at the pelvic inlet; soles of both hind and fore feet directed downwards. The fore feet are first encountered near the vulva.

Pr. 7 = Posterior Presentation: Lumbo-Sacral (Normal) Position.—Foal upright; hind feet presented, soles upwards.

Pr. 8 = Posterior Presentation: Lumbo-Pubic Position.—Foal on its back; hind feet press against roof of vagina; buttocks sink below the pubic brim.

Pr. 9 = Posterior (Hock) Presentation: Partial Retention of both Hind Limbs.—Hocks fully flexed at entrance to pelvis; analogous to knee flexion (Fig. 3), but more serious.

Pr. 10 = Posterior (Breech) Presentation (Thigh and Croup): Lumbo-Sacral Position.—Complete retention of both hind limbs; tail and buttocks at the pelvic inlet.

Pr. 11 = Transverse (Sterno-Abdominal) Presentation: Left Cephalo-Ilial Position.—Foal across the uterus, lower surface of chest and abdomen towards the pelvis; all four limbs in the passage. The heavy head frequently drops towards the floor of the uterus.

Pr. 12 = Transverse (Dorso-Lumbar) Presentation: Right Cephalo-Ilial Position.—Foal across the uterus, head to the right; back and loins at the pelvic inlet.

PLATE V.A.

Diagram of the Superficial Nerves of the Body.

1. Facial nerve.
2. Second cervical nerve.

3 to 6. Ventral branches of the cervical nerves from the third to the sixth inclusive.
7. Dorsal branches of cervical nerves.
8. Dorsal branches of thoracic nerves.
9. Cutaneous branches of lumbar nerves.
10. Cutaneous branches of sacral nerves.
11. Cutaneous branch of axillary nerve.
12. Cutaneous branch of the radial nerve.
13. Superficial ramus of the ulnar nerve.
14. Lateral volar (metacarpal) nerve.
15. Communicating branch from the medial to the lateral volar nerve.
16. Cutaneous branch of the ulnar nerve.
17 and 18. Cutaneous branches from the pectoral nerves.
19. Terminal cutaneous branches of intercostal nerves.
20. From the seventeenth thoracic nerve.
21. From the last thoracic nerve.
22. Superficial branch of the ilio-hypogastric nerve.
23. Superficial branch of the ilio-inguinal nerve.
24. Superficial peroneal nerve.
25 and 26. Posterior cutaneous nerve of the thigh.
27. From the common peroneal nerve.
28. Sural nerve.
29. Lateral plantar (metatarsal) nerve.

PLATE V.

Fig. 1.—Diagrammatic Representation of the Chief Nerves of the Body.

1. Maxillary nerve (N. maxillaris).
2. Ophthalmic nerve (N. ophthalmicus).
3. Mandibular nerve (N. mandibularis).
   1, 2, and 3 are parts of the fifth cerebral or trigeminal nerve.
4. Vagus (N. vagus). Lying alongside this nerve, and included in the same sheath, is the cervical cord or trunk of the sympathetic.
5. Recurrent nerve (N. recurrens), a branch of the vagus which arises in the thorax and travels back up the neck to end in the muscles of the larynx. The origin of the recurrent from the vagus is indicated at 13.
6. Accessory nerve (N. accessorius).
7. Suprascapular nerve (N. suprascapularis).
8. Musculo-cutaneous nerve (N. musculo-cutaneus).
9. Radial nerve (N. radialis).
10. Ulnar nerve (N. ulnaris).
11. Median nerve (N. medianus).
12. First thoracic ganglion of the sympathetic nervous system.
13. Origin of the recurrent nerve from the vagus.
14. Phrenic nerve (N. phrenicus).
15. Ventral œsophageal trunk formed by the union of the ventral branches of the two vagus nerves.
16. Dorsal œsophageal trunk formed by the union of the dorsal branches of the two vagus nerves.
17. Cœliaco-mesenteric ganglion (ganglion cœliaco-mesenterica), an important sympathetic ganglion controlling certain of the abdominal organs.
18. Last thoracic nerve.
19. Ilio-hypogastric nerve (N. ilio-hypogastricus).
20. Ilio-inguinal nerve (N. ilio-inguinalis).
21. Cranial (anterior) gluteal nerve (N. glutæus cranialis).
22. Sciatic nerve (N. ischiadicus).
23. Pudendal nerve (N. pudendus).
24. Hæmorrhoidal nerve (N. hæmorrhoidalis caudalis).
25. Caudal (posterior) gluteal nerve (N. glutæus caudalis).
26. Lateral cutaneous nerve of the thigh (N. cutaneus femoris lateralis).
27. Femoral nerve (N. femoralis).
28. Tibial nerve (N. tibialis).
29. Common peroneal nerve (N. peronæus communis).
30. Superficial peroneal nerve (N. peronæus superficialis).
31. Deep peroneal nerve (N. peronæus profundus).
32 and 33. Plantar nerves of the metatarsus and digit.
34. Volar nerves of the metacarpus.
35. Posterior cutaneous nerve of the thigh (N. cutaneus femoris posterior).
36. Saphenous nerve (N. saphenus).
37. Sural nerve (N. suralis).

The obturator nerve is shown in the figure, but is not provided with a number. It lies about midway between 21 and 27.

Fig. 2.—The Brain seen from Below (Base of the Brain).

1. Olfactory bulb (bulbus olfactorius).
2. Olfactory trigone (trigonum olfactorium).
3. The hemisphere of the cerebrum.
4. Optic tract (tractus opticus).
5. Pyriform lobe (lobus pyriformis).
6. Hypophysis cerebri, or pituitary body.
7. Cerebral peduncle (pedunculus cerebri).
8. Pons.
9. Medulla oblongata. The arrow points to one of the pyramids of the medulla.

II. Optic nerve (N. opticus).
III. Oculo-motor nerve (N. oculo-motorius).
IV. Trochlear nerve (N. trochlearis).
V. Trigeminal nerve (N. trigeminus).
VI. Abducent nerve (N. abducens).
VII. Facial nerve (N. facialis).
VIII. Acoustic nerve (N. acusticus).
IX. Glosso-pharyngeal nerve (N. glosso-pharyngeus).
X. Vagus nerve (N. vagus).
XI. Accessory nerve (N. accessorius).
XII. Hypoglossal nerve (N. hypoglossus).

The nerves marked II. to XII. are cerebral nerves (nervi cerebrales), and, in addition to the names above given, are known as the "second cerebral nerve," "third cerebral nerve," and so on.

Fig. 3.—Median Longitudinal Section of the Brain.

1. Cerebral hemisphere (hemisphærium cerebri).
2. Septum pellucidum.
3. Corpus callosum.
4. Fornix.
5. Suprapineal recess of the third ventricle.
6. Corpora quadrigemina.
7. Cerebellum.

DESCRIPTION OF PLATES

8. Posterior medullary velum (velum medullare posterius).
9. Medulla oblongata.
10. Fourth ventricle (ventriculus quartus).
11. Pons.
12. Anterior medullary velum (velum medullare anterius).
13. Aqueduct of cerebrum (aquæductus cerebri), which places the third and fourth ventricles in communication with each other.
14. Pineal body (corpus pineale).
15. Posterior commissure (commissura posterior).
16. Intermediate mass (massa intermedia) between the thalami.
17. Hypophysis cerebri, or pituitary body.
18. Infundibulum, a recess of the third ventricle extending into the hypophysis.
19. Third ventricle (ventriculus tertius).
20. Optic recess of the third ventricle.
21. Optic chiasma (chiasma opticum).
22. Anterior commissure (commissura anterior).
23. Olfactory bulb (bulbus olfactorius).

Fig. 4.—Diagram to show the Constitution of the Brachial Plexus and the Roots of the Phrenic Nerve.

6th C., 7th C., 8th C., 1st T. and 2nd T.: Roots of the plexus derived from the sixth, seventh, and eighth cervical and the first and second thoracic nerves.

1. Recurrent nerve (N. recurrens), a branch of the vagus.
2. Phrenic nerve (N. phrenicus).
3. Vagus (N. vagus).
4. First thoracic ganglion.

Fig. 5.—The Arrangement of Nerves about the End of the Spinal Cord—Cauda Equina.

1. The dura mater slit open to show—
2. The terminal part of the spinal cord.
3. Nerve-roots.

Fig. 6.—The Terminal Part of the Digit seen from Behind and Below.

Fig. 7.—The Terminal Part of the Digit seen from the Side.

(*To show the chief nerves.*)

1. The continuation of the volar nerve of the metacarpus.
2. That branch of the nerve which is continued into the interior of the third phalanx.

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